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Supporting information

Sunlight-promoted aerobic selective cyclization of olefinic amides and diselenides

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1. General information

Unless otherwise indicated, all the regents and solvents were purchased from commercial suppliers and used without any further purification. ^{1}H spectra were recorded in $CDCl_3$ on 400MHz NMR spectrometers and resonances (•) are given in parts per million relative to tetramethylsilane. Data are reported as follows: chemical shift, multiplicity (s = singlet, d = doublet, t = triplet, q =quartet, p = penta, dd = doublet of doublets, dt = doublet of triplets, ddt = doublet of doublet of triplets, dtd = doublet of triplet of doublets, m = multiplet, br = broad), coupling constant (J) in Hertz (Hz), and integration. ^{13}C NMR were recorded at 100 MHz and chemical data for carbons are reported in parts per million (ppm, δ scale) downfield from tetramethylsilane and are referenced to the carbon resonance of the solvent. Column chromatography was generally performed on Silicycle silica gel (200-300 mesh). Analytical thin-layer chromatography (TLC) was performed on 0.2 mm coated silica gel plates (HSGF 254) and visualized the course of the reactions using a UV light (254 nm or 365 nm). High-resolution mass spectra (HRMS) were obtained on an Agilent mass spectrometer using ESI-TOF (electrosprayionization-time of flight).

2. Reaction device

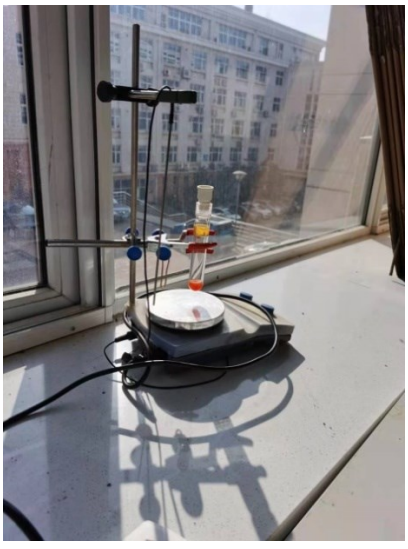
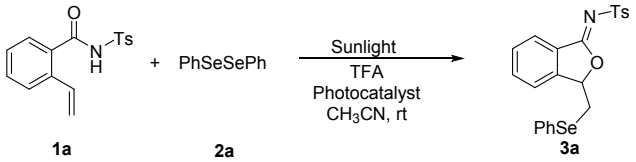


Figure S0. Reaction device

3. Screening of reaction conditions for *O*-cyclization reaction

Table S0. Screening of reaction conditions for the synthesis of product **3a**[a]



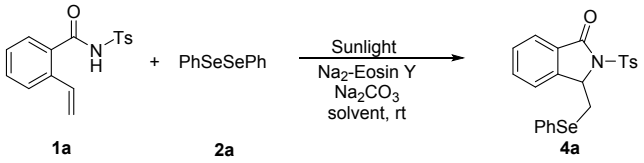
1a 2a 3a

Entry	Photocatalyst	Yield[b] (%)
1	-	**80**
2	Na_2-Eosin Y	74
3	Eosin Y	70
4	Acid Red 94	66
5	Fluorescein	61
6	-	52[c]
7	-	73[d]
8	-	76[e]

[a]Reaction conditions: **1a** (0.3 mmol), **2a** (0.3 mmol), Photocatalyst (2 mol%), TFA (0.2 equiv., 0.06 mmol), CH_3CN (2.5 mL), sunlight, room temperature, air, 3h. [b]Isolated yields. [c]0.5 equiv. of **2a**. [d]0.75 equiv. of **2a**. [e]1.5 equiv. of **2a**.

4. Screening of reaction conditions for the synthesis of product 4a[a]

Table S1. Screening of reaction conditions for the synthesis of product **4a**[a]



1a 2a 4a

Entry	Photocatalyst (equiv.)	Solvent	Yield[b] (%)
1	Na_2-Eosin Y (2 mol%)	CH_3CN	**54**
2	Na_2-Eosin Y (1 mol%)	CH_3CN	36
3	Na_2-Eosin Y (5 mol%)	CH_3CN	47
4	Na_2-Eosin Y (10 mol%)	CH_3CN	40
5	Na_2-Eosin Y (2 mol%)	DCE	22
6	Na_2-Eosin Y (2 mol%)	DMF	28
7	Na_2-Eosin Y (2 mol%)	DMSO	trace
8	Na_2-Eosin Y (2 mol%)	1,4-Dioxane	21
9	Na_2-Eosin Y (2 mol%)	THF	trace
10	Na_2-Eosin Y (2 mol%)	CH_3CN	50[c]
11	Na_2-Eosin Y (2 mol%)	CH_3CN	46[d]
12	Na_2-Eosin Y (2 mol%)	CH_3CN	41[e]
13	Na_2-Eosin Y (2 mol%)	CH_3CN	30[f]
14	Na_2-Eosin Y (2 mol%)	CH_3CN	45[g]
15	Na_2-Eosin Y (2 mol%)	CH_3CN	51[h]

[a]Reaction conditions: **1a** (0.3 mmol), **2a** (0.3 mmol), Na_2-Eosin Y (equiv.), Na_2CO_3 (1 equiv.), solvent (2.5 mL), sunlight, room temperature, air, 3h. [b]Isolated yields. [c]Blue. [d]White. [e]Green. [f]0.5 equiv. of **2a**. [g]0.75 equiv. of **2a**. [h]1.5 equiv. of **2a**.

5. X-ray crystallography structure of compound 3a and 4a

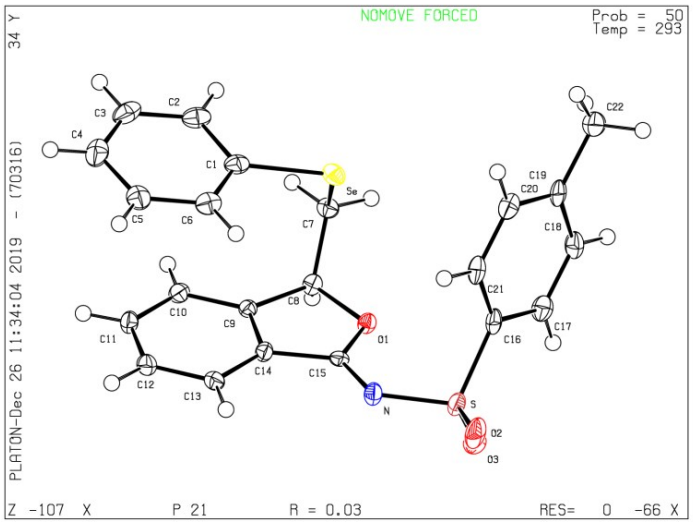


Figure S1. X-ray structure of **3a**

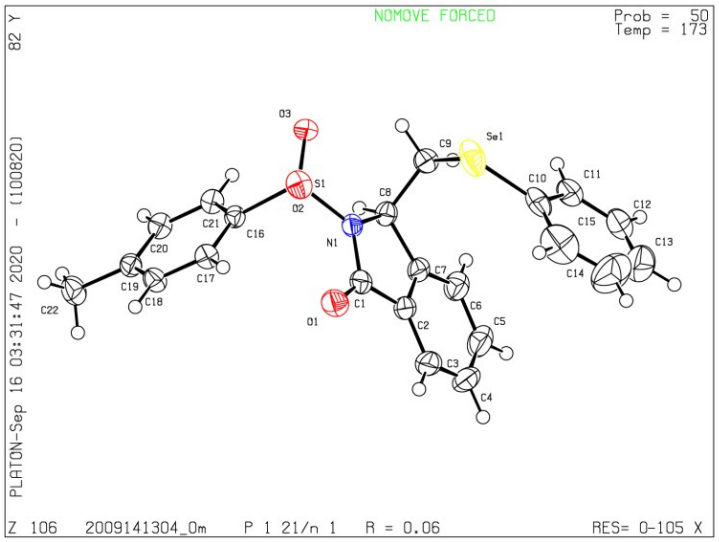


Figure S2. X-ray structure of **4a**

6. General procedure for the derivatization of 3s

A 35 mL glass tube was charged with substrate **3s** (0.5 mmol), 2M HCl (2mL), CH_3CN (4 mL) and a magnetic stir bar. The reaction mixture was stirred at room

temperature for overnight. After completing reaction, it was monitored with TLC. Then the reaction mixture was washed with saturated NaCl solution and extracted with ethyl acetate. The organic layer was dried with anhydrous sodium sulfate and the solvent was removed under vacuum. The pure product **5** was obtained by flash chromatography on silica gel using petroleum ether and ethyl acetate as the eluent.

7. HRMS Spectra

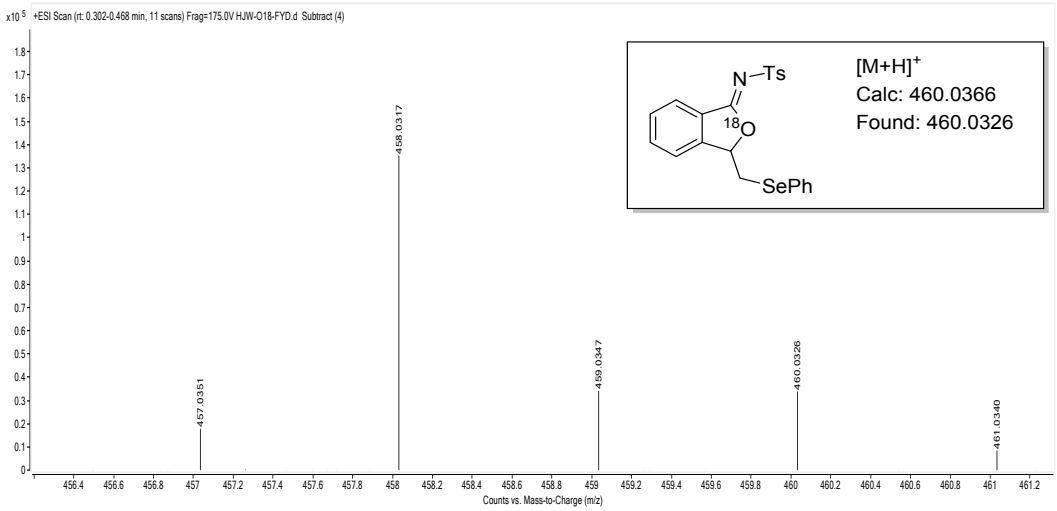


Figure S3-1. HRMS Spectra for compound **^{18}O-3a**

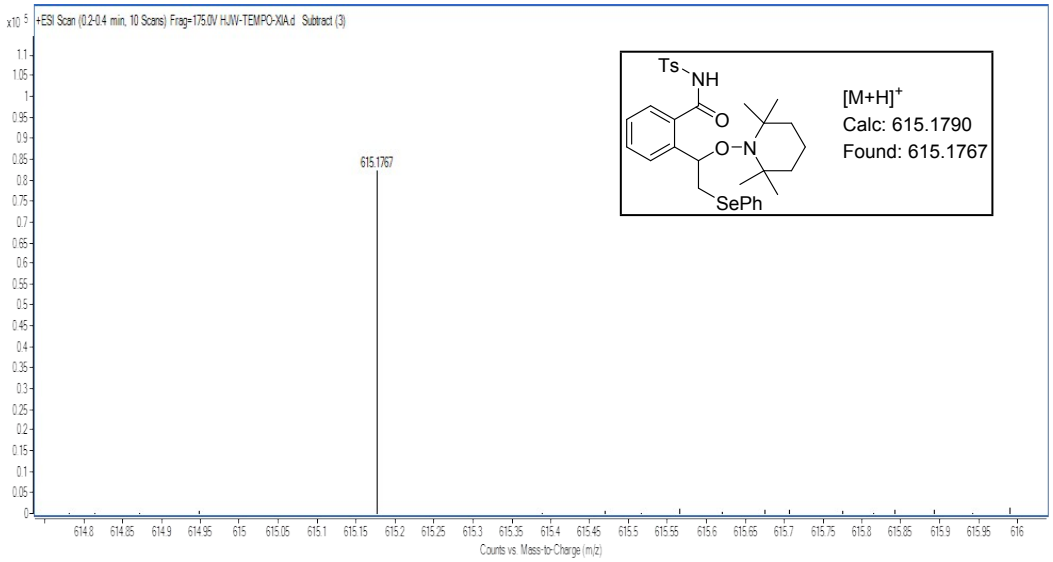


Figure S3-2. HRMS Spectra for compound **6**

8. Fluorescence quenching experiments

The fluorescence emission intensities were recorded on spespectrofluorimeter. The

excitation wavelength was fixed at 525 nm. In a typical experiment, the emission spectrum of a 0.1 mM solution of PC in CH_3CN was collected. Then, different amount of **1a** or **2a** was added to the measured solution and the emission spectrum of the sample was collected. Here I_0 and I represent the intensities of the emission in the absence and presence of the quencher.

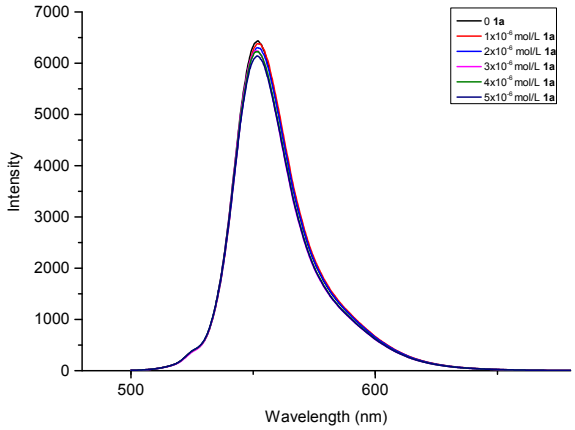


Figure S4. Quenching of Na_2-EosinY fluorescence emission in the presence of **1a**

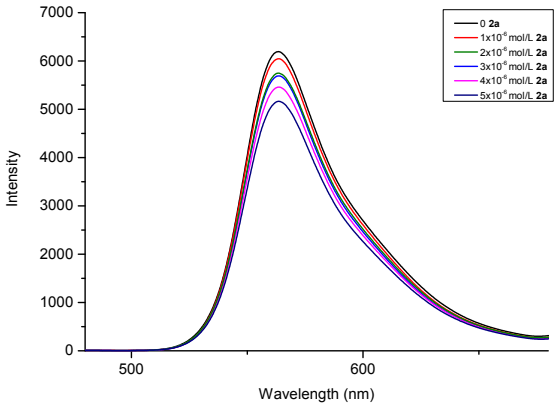


Figure S5. Quenching of Na_2-EosinY fluorescence emission in the presence of **2a**

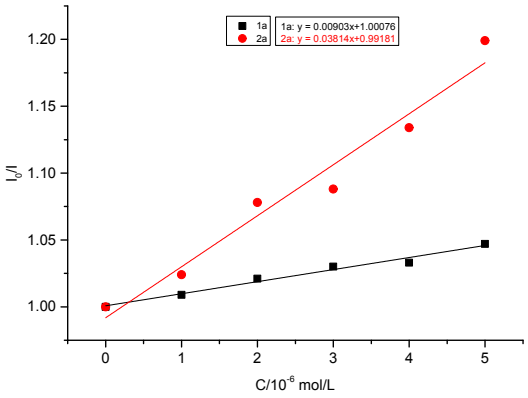
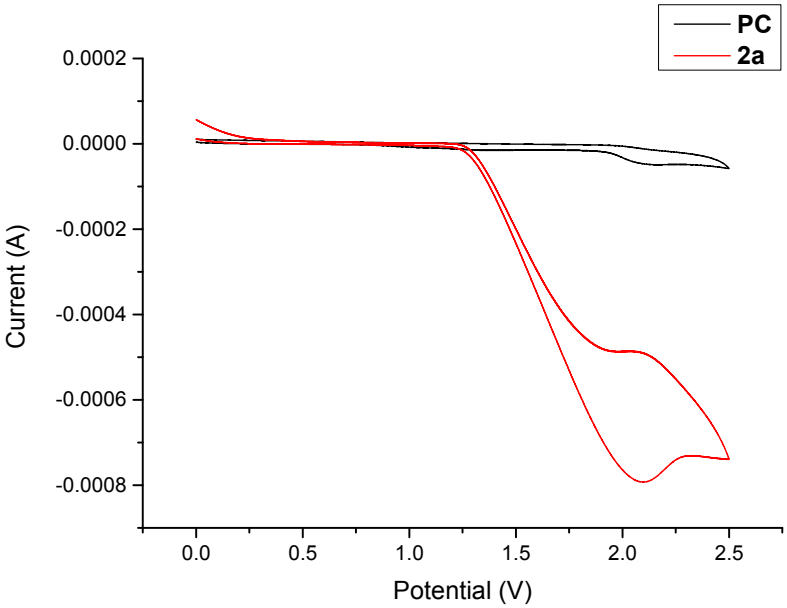


Figure S6. Stern-volmer plots

9. Cyclic voltammetry experiment

Cyclic voltammograms of diphenyl diselenide and Na_2-EosinY were performed in a three-electrode cell connected to a schlenk line under nitrogen at room temperature. The working electrode was a steady glassy carbon disk electrode while the counter electrode was a platinum wire. The reference was an Ag/AgCl electrode submerged in saturated aqueous KCl solution. (1) Diphenyl diselenide (0.3mmol) and a solvent (MeCN, 20 mL) containing $^{n}Bu_4NBF_4$ (0.3 mmol) were poured into the electrochemical cell in cyclic voltammetry experiments. The scan rate was 0.10 V/s, ranging from 0 V to 2.5 V, -2.5 V to 0 V. (2) Na_2-EosinY (0.006mmol) and a solvent (MeCN, 20 mL) containing $^{n}Bu_4NBF_4$ (0.3 mmol) were poured into the electrochemical cell in cyclic voltammetry experiments. The scan rate was 0.10 V/s, ranging from 0 V to 2.5 V, -2.5 V to 0 V.



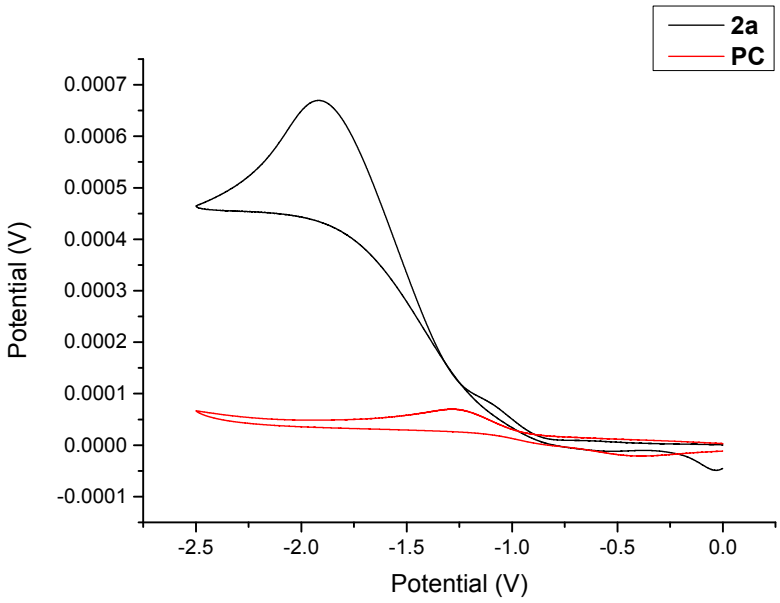
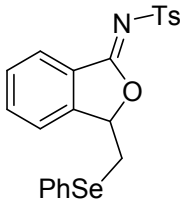
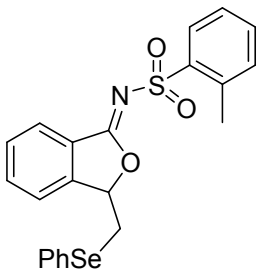


Figure S7. Cyclic voltammograms of PC and **2a**

10. Analytical data of compounds 3, 4, 5

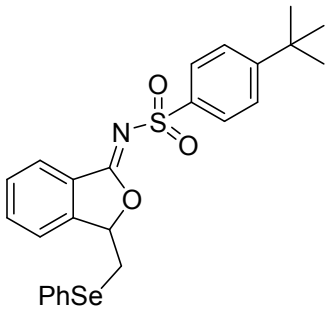


(Z)-4-methyl-N-(3-((phenylselanyl)methyl)isobenzofuran-1(3H)-ylidene)benzenesulfonamide **(3a)**. White solid (80%, 0.110g). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.94 – 7.88 (m, 2H), 7.81 (d, *J* = 6.7 Hz, 1H), 7.44 – 7.37 (m, 2H), 7.33 (dd, *J* = 6.2, 1.8 Hz, 1H), 7.31 – 7.26 (m, 2H), 7.22 (d, *J* = 8.1 Hz, 2H), 7.19 – 7.15 (m, 1H), 7.15 – 7.09 (m, 2H), 5.79 (dd, *J* = 6.4, 4.8 Hz, 1H), 3.31 (dd, *J* = 13.3, 4.7 Hz, 1H), 3.14 (dd, *J* = 13.3, 6.6 Hz, 1H), 2.33 (s, 3H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 166.04 , 145.43 , 142.46 , 137.18 , 133.17 , 132.78 , 128.79 , 128.26 , 128.16 , 127.49 , 126.91 , 126.82 , 124.40 , 121.12 , 85.07 , 30.27 , 20.59 . HRMS (TOF) m/z [M + H]$^{+}$ Calcd for $C_{22}H_{20}NO_3SSe$ 458.0324 found 458.0328.

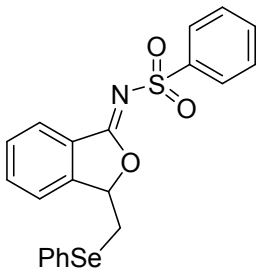


(Z)-2-methyl-N-(3-((phenylselanyl)methyl)isobenzofuran-1(3H)-ylidene)benzenesulfonamide **(3b)**. White solid (75%, 0.103g). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.11 (dd, *J* = 7.9, 1.2 Hz, 1H), 7.83 (d, *J* = 5.2 Hz, 1H), 7.45 – 7.40 (m, 2H), 7.37 (ddt, *J* = 7.5, 5.5, 1.5 Hz, 2H), 7.30 – 7.20 (m, 4H), 7.18 – 7.15 (m, 1H), 7.15 – 7.09 (m, 2H), 5.78 (dd, *J* = 7.0, 4.2 Hz, 1H), 3.34 (dd, *J* = 13.3, 4.2 Hz, 1H),

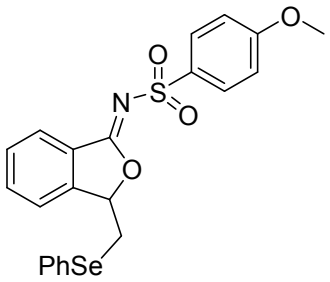
3.08 (dd, *J* = 13.3, 7.0 Hz, 1H), 2.67 (s, 3H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 166.13 , 145.58 , 138.79 , 136.88 , 133.14 , 132.82 , 131.58 , 131.07 , 128.83 , 128.36 , 128.26 , 127.86 , 127.43 , 126.92 , 124.65 , 124.26 , 121.26 , 84.98 , 30.19 , 19.68 . HRMS (TOF) m/z $[M + H]^+$ Calcd for $C_{22}H_{20}NO_3SSe$ 458.0324 found 458.0322.



(Z)-4-(tert-butyl)-N-(3-((phenylselanyl)methyl)isobenzofuran-1(3H)-ylidene)benzenesulfonamide **(3c)**. White solid (78%, 0.117g). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.96 (d, *J* = 8.3 Hz, 2H), 7.87 – 7.79 (m, 1H), 7.47 – 7.37 (m, 4H), 7.35 – 7.26 (m, 3H), 7.15 (dq, *J* = 14.7, 7.2, 6.4 Hz, 3H), 5.79 (t, *J* = 5.6 Hz, 1H), 3.29 (dd, *J* = 13.3, 4.5 Hz, 1H), 3.13 (dd, *J* = 13.3, 6.7 Hz, 1H), 1.26 (s, 9H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 166.01 , 155.39 , 145.47 , 137.16 , 133.13 , 132.83 , 128.78 , 128.34 , 128.27 , 127.53 , 126.92 , 126.64 , 124.55 , 124.45 , 121.12 , 85.04 , 34.11 , 30.25 , 30.11 . HRMS (TOF) m/z $[M + H]^+$ Calcd for $C_{25}H_{26}NO_3SSe$ 500.0793 found 500.0797.

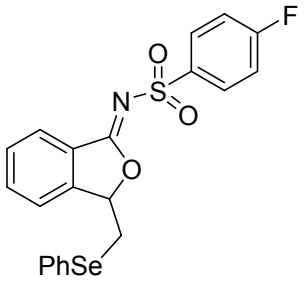


(Z)-N-(3-((phenylselanyl)methyl)isobenzofuran-1(3H)-ylidene)benzenesulfonamide (**3d**). White solid (77%, 0.102g). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.06 – 8.00 (m, 2H), 7.83 (d, *J* = 7.1 Hz, 1H), 7.52 – 7.47 (m, 1H), 7.46 – 7.38 (m, 4H), 7.34 (dd, *J* = 5.8, 2.3 Hz, 1H), 7.31 – 7.26 (m, 2H), 7.20 – 7.10 (m, 3H), 5.79 (dd, *J* = 6.5, 4.8 Hz, 1H), 3.30 (dd, *J* = 13.3, 4.6 Hz, 1H), 3.12 (dd, *J* = 13.3, 6.7 Hz, 1H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 167.28 , 146.59 , 141.30 , 134.31 , 133.84 , 132.70 , 129.88 , 129.33 , 129.28 , 128.61 , 128.54 , 127.98 , 127.76 , 125.52 , 122.21 , 86.25 , 31.25 . HRMS (TOF) m/z $[M + H]^+$ Calcd for $C_{21}H_{18}NO_3SSe$ 444.0167 found 444.0162.

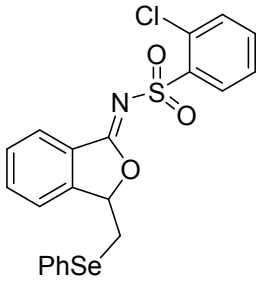


(Z)-4-methoxy-N-(3-((phenylselanyl)methyl)isobenzofuran-1(3H)-ylidene)benzenesulfonamide **(3e)**. White solid (75%, 0.106g). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.07 – 8.01 (m, 2H), 7.90 – 7.82 (m, 1H), 7.48 – 7.42 (m, 2H), 7.38 – 7.28 (m, 3H), 7.25 – 7.13 (m, 3H), 6.99 – 6.93 (m, 2H),

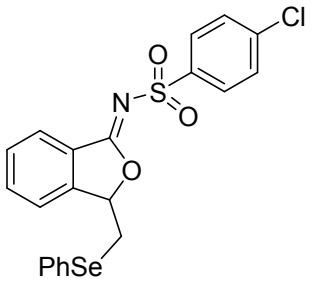
5.89 (t, *J* = 5.3 Hz, 1H), 3.82 (s, 3H), 3.35 (dd, *J* = 13.4, 4.8 Hz, 1H), 3.27 (dd, *J* = 13.4, 6.0 Hz, 1H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 166.96 , 163.04 , 146.41 , 134.27 , 133.68 , 132.87 , 130.04 , 129.83 , 129.25 , 128.73 , 127.83 , 125.23 , 122.20 , 113.80 , 86.23 , 55.69 , 31.48 . HRMS (TOF) m/z [M + H]$^+$ Calcd for $C_{22}H_{20}NO_4SSe$ 474.0273 found 474.0279.



(Z)-4-fluoro-N-(3-((phenylselanyl)methyl)isobenzofuran-1(3H)-ylidene)benzenesulfonamide **(3f)**. White solid (79%, 0.109g). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.02 (ddd, *J* = 10.0, 5.1, 2.5 Hz, 2H), 7.81 – 7.71 (m, 1H), 7.42 – 7.35 (m, 2H), 7.30 – 7.25 (m, 1H), 7.24 – 7.19 (m, 2H), 7.16 – 7.03 (m, 5H), 5.82 (t, *J* = 5.4 Hz, 1H), 3.28 (dd, *J* = 13.4, 4.7 Hz, 1H), 3.18 (dd, *J* = 13.5, 6.1 Hz, 1H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 166.49 , 164.11 (d, *J* = 252 Hz) , 145.51 , 136.27 (d, *J* = 3 Hz) , 133.44 , 132.70 , 129.56 (d, *J* = 9 Hz) , 128.88 , 128.24 , 128.02 , 127.51 , 126.88 , 124.32 , 121.17 , 114.77 (d, *J* = 23 Hz) , 85.43 , 30.34 . ^{19}F NMR (376 MHz, Chloroform-*d*) δ -105.29 . HRMS (TOF) m/z [M + H]$^+$ Calcd for $C_{21}H_{17}FNO_3SSe$ 462.0073 found 462.0070.

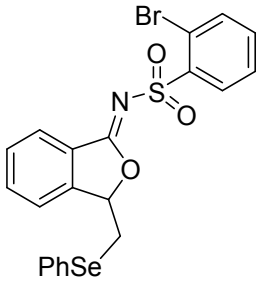


(Z)-2-chloro-N-(3-((phenylselanyl)methyl)isobenzofuran-1(3H)-ylidene)benzenesulfonamide **(3g)**. White solid (73%, 0.105g). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.19 (d, *J* = 7.6 Hz, 1H), 7.83 (s, 1H), 7.45 – 7.38 (m, 4H), 7.38 – 7.32 (m, 2H), 7.29 – 7.25 (m, 2H), 7.18 – 7.08 (m, 3H), 5.77 (dd, *J* = 6.6, 4.6 Hz, 1H), 3.30 (dd, *J* = 13.3, 4.5 Hz, 1H), 3.08 (dd, *J* = 13.3, 6.8 Hz, 1H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 167.44 , 146.71 , 139.40 , 134.44 , 133.81 , 133.52 , 132.75 , 131.60 , 130.54 , 129.96 , 129.31 , 129.13 , 128.50 , 127.94 , 126.72 , 125.55 , 122.27 , 86.39 , 31.11 . HRMS (TOF) m/z [M + H]$^+$ Calcd for $C_{21}H_{17}ClNO_3SSe$ 477.9777 found 477.9770.

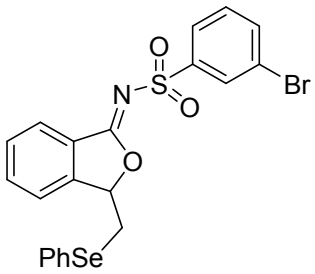


(Z)-4-chloro-N-(3-((phenylselanyl)methyl)isobenzofuran-1(3H)-ylidene)benzenesulfonamide **(3h)**. White solid (80%, 0.114g). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.00 – 7.94 (m, 2H), 7.83 (d, *J* = 7.1 Hz, 1H), 7.48 – 7.38 (m, 4H), 7.38 – 7.34 (m, 1H), 7.34 – 7.28 (m, 2H), 7.20 – 7.11 (m, 3H), 5.82 (dd, *J* = 6, 5.2 Hz, 1H) , 3.33 (dd, *J* = 13.3, 4.8 Hz, 1H), 3.18 (dd, *J* = 13.3, 6.5 Hz, 1H). ^{13}C NMR (101

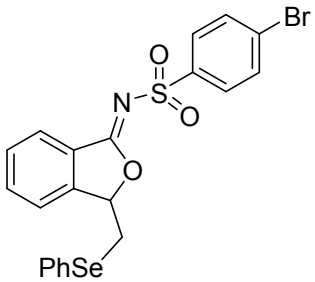
MHz, Chloroform-*d*) δ 166.44 , 145.63 , 138.81 , 138.12 , 133.43 , 132.87 , 128.93 , 128.35 , 128.28 , 128.12 , 127.86 , 127.40 , 127.03 , 124.54 , 121.15 , 85.39 , 30.21 . HRMS (TOF) m/z [M + H]$^+$ Calcd for $C_{21}H_{17}ClNO_3SSe$ 477.9777 found 477.9772.



(Z)-2-bromo-N-(3-((phenylselanyl)methyl)isobenzofuran-1(3H)-ylidene)benzenesulfonamide (**3i**). White solid (74%, 0.115g). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.27 – 8.19 (m, 1H), 7.86 (d, *J* = 6.8 Hz, 1H), 7.64 (d, *J* = 7.8 Hz, 1H), 7.42 (dq, *J* = 20.8, 6.7, 6.3 Hz, 4H), 7.31 (dd, *J* = 10.9, 7.5 Hz, 3H), 7.15 (dq, *J* = 14.3, 6.8 Hz, 3H), 5.78 (dd, *J* = 6, 4.8 Hz, 1H), 3.32 (dd, *J* = 13.3, 4.4 Hz, 1H), 3.09 (dd, *J* = 13.3, 6.9 Hz, 1H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 166.32 , 145.71 , 140.17 , 134.06 , 133.37 , 132.79 , 132.41 , 129.69 , 128.93 , 128.30 , 128.16 , 127.47 , 126.92 , 126.27 , 124.57 , 121.23 , 119.87 , 85.35 , 30.07 . HRMS (TOF) m/z [M + H]$^+$ Calcd for $C_{21}H_{17}BrNO_3SSe$ 521.9272 found 521.9278.

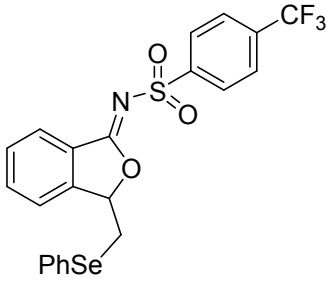


(Z)-3-bromo-N-(3-((phenylselanyl)methyl)isobenzofuran-1(3H)-ylidene)benzenesulfonamide **(3j)**. White solid (73%, 0.114g). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.24 (t, *J* = 1.8 Hz, 1H), 8.03 (ddd, *J* = 7.9, 1.6, 1.0 Hz, 1H), 7.86 (dd, *J* = 6.1, 2.5 Hz, 1H), 7.67 (ddd, *J* = 8.0, 1.9, 1.0 Hz, 1H), 7.50 – 7.44 (m, 2H), 7.40 (d, *J* = 7.9 Hz, 1H), 7.37 – 7.33 (m, 1H), 7.31 – 7.27 (m, 2H), 7.23 – 7.18 (m, 1H), 7.18 – 7.12 (m, 2H), 5.93 (t, *J* = 5.2 Hz, 1H), 3.38 (dd, *J* = 13.5, 4.6 Hz, 1H), 3.28 (dd, *J* = 13.5, 6.0 Hz, 1H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 167.95 , 146.64 , 143.01 , 135.75 , 134.64 , 133.67 , 130.74 , 130.37 , 129.97 , 129.27 , 128.91 , 128.62 , 127.88 , 126.42 , 125.35 , 122.45 , 122.28 , 86.64 , 31.39 . HRMS (TOF) m/z [M + H]$^+$ Calcd for $C_{21}H_{17}BrNO_3SSe$ 521.9272 found 521.9280.

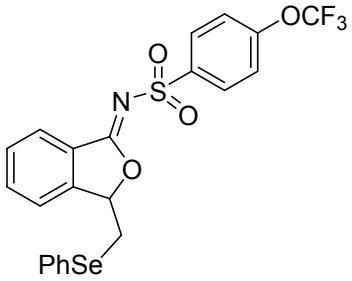


(Z)-4-bromo-N-(3-((phenylselanyl)methyl)isobenzofuran-1(3H)-ylidene)benzenesulfonamide **(3k)**. White solid (79%, 0.124g). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.92 – 7.87 (m, 2H), 7.82 (d, *J* = 7.1 Hz, 1H), 7.60 – 7.54 (m, 2H), 7.43 (tt, *J* = 7.3, 3.8 Hz, 2H), 7.38 – 7.34 (m, 1H), 7.34 – 7.29 (m, 2H), 7.22 – 7.11 (m, 3H), 5.81 (dd, *J* = 6.4, 4.8 Hz, 1H), 3.32 (dd, *J* = 13.3, 4.8 Hz, 1H), 3.18 (dd, *J* = 13.3,

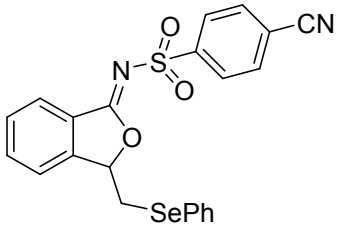
6.5 Hz, 1H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 166.47 , 145.63 , 139.34 , 133.45 , 132.87 , 130.85 , 128.93 , 128.39 , 128.34 , 128.10 , 127.41 , 127.02 , 126.65 , 124.53 , 121.15 , 85.41 , 30.22 . HRMS (TOF) m/z [M + H]$^+$ Calcd for $C_{21}H_{17}BrNO_3SSe$ 521.9272 found 521.9275.



(Z)-N-(3-((phenylselanyl)methyl)isobenzofuran-1(3H)-ylidene)-4-(trifluoromethyl)benzenesulfonamide **(3l)**. White solid (69%, 0.106g). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.12 (d, *J* = 8.2 Hz, 2H), 7.78 – 7.72 (m, 1H), 7.65 (d, *J* = 8.4 Hz, 2H), 7.39 – 7.32 (m, 2H), 7.27 – 7.21 (m, 1H), 7.19 – 7.14 (m, 2H), 7.11 – 7.06 (m, 1H), 7.05 – 6.99 (m, 2H), 5.82 (t, *J* = 5.3 Hz, 1H), 3.28 – 3.16 (m, 2H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 168.17 , 146.73 , 144.81 , 134.70 , 134.17 (t, *J* = 32.6 Hz) , 133.71 , 129.98 , 129.27 , 128.87 , 128.55 , 128.37 , 127.90 , 125.81 (q, *J* = 3.6 Hz) , 125.37 , 123.40 (q, *J* = 271.3 Hz) , 122.26 , 86.78 , 31.34 . ^{19}F NMR (376 MHz, Chloroform-*d*) δ -62.88 . HRMS (TOF) m/z [M + H]$^+$ Calcd for $C_{22}H_{17}F_3NO_3SSe$ 512.0041 found 512.0046.

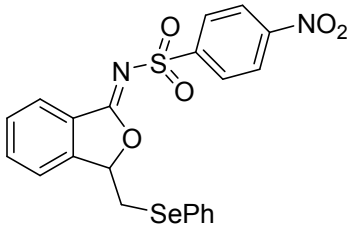


(Z)-N-(3-((phenylselanyl)methyl)isobenzofuran-1(3H)-ylidene)-4-(trifluoromethoxy)benzenesulfonamide **(3m)**. White solid (72%, 0.114g). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.07 (d, *J* = 8.8 Hz, 2H), 7.79 (d, *J* = 6.4 Hz, 1H), 7.44 – 7.35 (m, 2H), 7.32 – 7.28 (m, 1H), 7.24 (d, *J* = 7.9 Hz, 4H), 7.16 – 7.11 (m, 1H), 7.11 – 7.05 (m, 2H), 5.82 (t, *J* = 5.4 Hz, 1H), 3.28 (dd, *J* = 13.4, 4.8 Hz, 1H), 3.19 (dd, *J* = 13.4, 6.2 Hz, 1H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 166.71 , 151.12 , 145.63 , 138.70 , 133.53 , 132.77 , 128.98 , 128.92 , 128.27 , 128.01 , 127.48 , 126.93 , 124.42 , 121.20 , 119.53 , 119.24 (q, *J* = 258 Hz), 85.55 , 30.27 . ^{19}F NMR (376 MHz, Chloroform-*d*) δ -57.59 . HRMS (TOF) m/z [M + H]$^+$ Calcd for $C_{22}H_{17}F_3NO_4SSe$ 527.9990 found 527.9993.

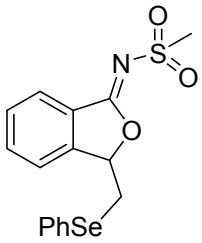


(Z)-4-cyano-N-(3-((phenylselanyl)methyl)isobenzofuran-1(3H)-ylidene)benzenesulfonamide **(3n)**. White solid (70%, 0.098g). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.16 – 8.09 (m, 2H), 7.80 (d, *J* = 6.6 Hz, 1H), 7.72 (d, *J* = 8.5 Hz, 2H), 7.49 – 7.40 (m, 2H), 7.35 – 7.30 (m, 1H), 7.27 – 7.22 (m, 2H), 7.19

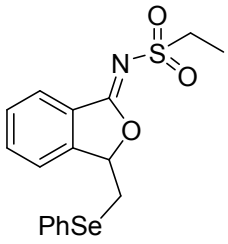
– 7.08 (m, 3H), 5.86 (t, *J* = 5.3 Hz, 1H), 3.31 (dd, *J* = 13.4, 4.7 Hz, 1H), 3.22 (dd, *J* = 13.5, 6.1 Hz, 1H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 167.26 , 145.71 , 144.33 , 133.76 , 132.73 , 131.49 , 129.03 , 128.32 , 127.79 , 127.38 , 127.01 , 124.49 , 121.21 , 116.56 , 115.18 , 85.77 , 30.24 . HRMS (TOF) m/z [M + H]$^+$ Calcd for $C_{22}H_{17}N_2O_3SSe$ 469.0120 found 469.0135.



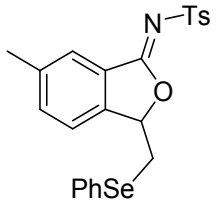
(Z)-4-nitro-N-(3-((phenylselanyl)methyl)isobenzofuran-1(3H)-ylidene)benzenesulfonamide **(3o)**. White solid (61%, 0.089g). ^{1}H NMR (400 MHz, DMSO-*d*$_6$) δ 8.48 – 8.42 (m, 2H), 8.33 – 8.27 (m, 2H), 7.94 (d, *J* = 7.4 Hz, 1H), 7.71 – 7.56 (m, 3H), 7.29 – 7.17 (m, 5H), 6.39 (t, *J* = 4.4 Hz, 1H), 3.70 (dd, *J* = 13.6, 4.4 Hz, 1H), 3.63 (dd, *J* = 13.6, 4.7 Hz, 1H). ^{13}C NMR (101 MHz, DMSO-*d*$_6$) δ 169.09 , 150.28 , 147.83 , 146.70 , 135.48 , 132.44 , 130.47 , 129.53 , 129.50 , 129.47 , 128.53 , 127.52 , 125.11 , 124.82 , 123.20 , 88.04 , 30.86 . HRMS (TOF) m/z [M + H]$^+$ Calcd for $C_{21}H_{17}N_2O_5SSe$ 489.0018 found 489.0027.



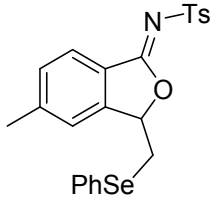
(Z)-N-(3-((phenylselanyl)methyl)isobenzofuran-1(3H)-ylidene)methanesulfonamide **(3p)**. White solid (77%, 0.088g). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.73 (d, *J* = 6.1 Hz, 1H), 7.44 – 7.32 (m, 3H), 7.27 – 7.21 (m, 2H), 7.12 – 7.01 (m, 3H), 5.88 (dd, *J* = 6.2, 4.3 Hz, 1H), 3.43 (dd, *J* = 13.5, 4.3 Hz, 1H), 3.30 (dd, *J* = 13.5, 6.2 Hz, 1H), 3.04 (s, 3H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 167.28 , 146.72 , 134.49 , 133.59 , 129.92 , 129.29 , 128.88 , 128.64 , 127.81 , 125.07 , 122.34 , 86.38 , 42.20 , 31.36 . HRMS (TOF) m/z [M + H]$^+$ Calcd for $C_{16}H_{16}NO_3SSe$ 382.0011 found 382.0019.



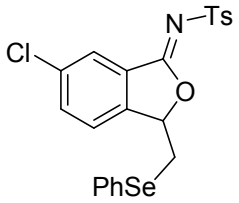
(Z)-N-(3-((phenylselanyl)methyl)isobenzofuran-1(3H)-ylidene)ethanesulfonamide **(3q)**. White solid (74%, 0.087g). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.76 (d, *J* = 7.1 Hz, 1H), 7.41 (ddt, *J* = 10.9, 7.1, 3.6 Hz, 3H), 7.29 (dd, *J* = 7.9, 1.4 Hz, 2H), 7.15 – 7.03 (m, 3H), 5.85 (dd, *J* = 6.5, 4.2 Hz, 1H), 3.47 (dd, *J* = 13.4, 4.1 Hz, 1H), 3.25 (dd, *J* = 13.4, 6.7 Hz, 1H), 3.14 (qd, *J* = 7.3, 2.0 Hz, 2H), 1.36 (t, *J* = 7.4 Hz, 3H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 167.42 , 146.74 , 134.35 , 133.67 , 129.87 , 129.29 , 129.05 , 128.60 , 127.84 , 125.09 , 122.39 , 86.10 , 48.82 , 31.31 , 8.30 . HRMS (TOF) m/z [M + H]$^+$ Calcd for $C_{17}H_{18}NO_3SSe$ 396.0167 found 396.0159.



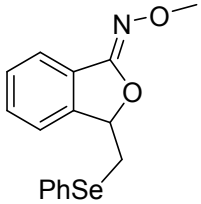
(Z)-4-methyl-N-(6-methyl-3-((phenylselanyl)methyl)isobenzofuran-1(3H)-ylidene)benzenesulfonamide **(3r)**. White solid (80%, 0.113g). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.87 (d, *J* = 8.3 Hz, 2H), 7.52 (s, 1H), 7.21 – 7.14 (m, 4H), 7.13 – 7.07 (m, 3H), 7.06 – 7.00 (m, 2H), 5.73 (t, *J* = 5.3 Hz, 1H), 3.23 (dd, *J* = 13.4, 4.7 Hz, 1H), 3.11 (dd, *J* = 13.4, 6.0 Hz, 1H), 2.27 (s, 3H), 2.24 (s, 3H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 167.41 , 143.99 , 143.48 , 140.17 , 138.34 , 135.48 , 133.60 , 129.34 , 129.21 , 129.15 , 128.79 , 127.84 , 127.73 , 125.11 , 121.94 , 86.21 , 31.66 , 21.61 , 21.21 . HRMS (TOF) m/z [M + H]$^{+}$ Calcd for $C_{23}H_{22}NO_3SSe$ 472.0480 found 472.0471.



(Z)-4-methyl-N-(5-methyl-3-((phenylselanyl)methyl)isobenzofuran-1(3H)-ylidene)benzenesulfonamide **(3s)**. White solid (78%, 0.111g). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.91 (d, *J* = 8.3 Hz, 2H), 7.70 (d, *J* = 7.8 Hz, 1H), 7.28 – 7.21 (m, 3H), 7.21 – 7.17 (m, 2H), 7.17 – 7.08 (m, 3H), 7.04 (s, 1H), 5.75 (dd, *J* = 6, 4.8 Hz, 1H), 3.28 (dd, *J* = 13.4, 4.5 Hz, 1H), 3.14 (dd, *J* = 13.4, 6.4 Hz, 1H), 2.33 (s, 3H), 2.24 (s, 3H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 166.20 , 145.90 , 144.78 , 142.32 , 137.45 , 132.82 , 129.97 , 128.15 , 128.11 , 127.66 , 126.86 , 126.83 , 125.78 , 124.17 , 121.51 , 84.76 , 30.41 , 21.02 , 20.57 . HRMS (TOF) m/z [M + H]$^{+}$ Calcd for $C_{23}H_{22}NO_3SSe$ 472.0480 found 472.0489.

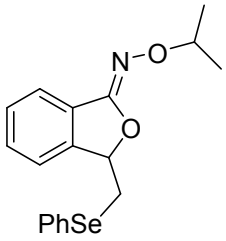


(Z)-N-(6-chloro-3-((phenylselanyl)methyl)isobenzofuran-1(3H)-ylidene)-4-methylbenzenesulfonamide **(3t)**. White solid (82%, 0.120g). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.85 (d, *J* = 8.3 Hz, 2H), 7.67 (s, 1H), 7.19 (d, *J* = 8.1 Hz, 3H), 7.16 – 7.08 (m, 4H), 7.03 (t, *J* = 7.3 Hz, 2H), 5.82 (dd, *J* = 5.6, 4.4 Hz, 1H), 3.30 (dd, *J* = 13.6, 4.1 Hz, 1H), 3.16 (dd, *J* = 13.6, 6.0 Hz, 1H), 2.30 (s, 3H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 165.77 , 144.63 , 143.81 , 137.95 , 135.97 , 134.18 , 133.63 , 131.10 , 129.30 , 129.20 , 128.65 , 127.88 , 127.85 , 124.78 , 123.58 , 86.06 , 31.69 , 21.65 . HRMS (TOF) m/z [M + H]$^{+}$ Calcd for $C_{22}H_{19}ClNO_3SSe$ 491.9934 found 491.9942.

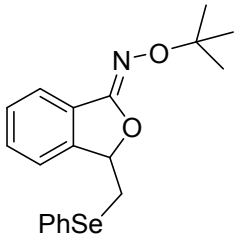


(Z)-3-((phenylselanyl)methyl)isobenzofuran-1(3H)-one O-methyl oxime **(3u)**. White solid (81%, 0.080g). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.55 (dd, *J* = 6.5, 1.5 Hz, 1H), 7.38 – 7.34 (m, 2H),

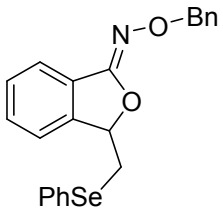
7.34 – 7.31 (m, 1H), 7.24 (pd, *J* = 7.3, 1.2 Hz, 2H), 7.13 – 7.06 (m, 3H), 5.60 (dd, *J* = 7.0, 4.4 Hz, 1H), 3.82 (s, 3H), 3.36 (dd, *J* = 13.1, 4.4 Hz, 1H), 3.13 (dd, *J* = 13.1, 7.1 Hz, 1H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 155.66 , 143.28 , 133.47 , 130.65 , 129.20 , 129.15 , 129.12 , 128.86 , 127.56 , 122.19 , 121.59 , 83.91 , 62.70 , 32.19 . HRMS (TOF) m/z [M + H]$^+$ Calcd for $C_{16}H_{16}NO_2Se$ 334.0341 found 334.0331.



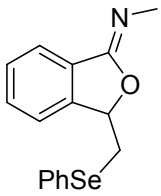
(Z)-3-((phenylselanyl)methyl)isobenzofuran-1(3H)-one O-isopropyl oxime **(3v)**. White solid (77%, 0.083g). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.57 (dd, *J* = 6.2, 1.8 Hz, 1H), 7.45 – 7.39 (m, 2H), 7.37 (dd, *J* = 6.0, 2.1 Hz, 1H), 7.30 – 7.21 (m, 2H), 7.11 (qd, *J* = 4.9, 1.7 Hz, 3H), 5.63 (dd, *J* = 7.4, 4.0 Hz, 1H), 4.24 (p, *J* = 6.2 Hz, 1H), 3.41 (dd, *J* = 13.1, 4.0 Hz, 1H), 3.12 (dd, *J* = 13.1, 7.5 Hz, 1H), 1.23 (d, *J* = 6.3 Hz, 6H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 142.12 , 132.57 , 129.29 , 128.35 , 128.12 , 128.09 , 127.96 , 126.49 , 121.09 , 120.47 , 82.59 , 75.03 , 31.36 , 20.55 . HRMS (TOF) m/z [M + H]$^+$ Calcd for $C_{18}H_{20}NO_2Se$ 362.0654 found 362.0647.



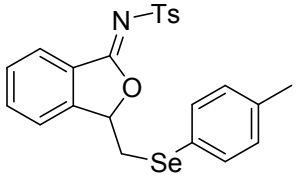
(Z)-3-((phenylselanyl)methyl)isobenzofuran-1(3H)-one O-(tert-butyl) oxime **(3w)**. White solid (82%, 0.093g). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.68 (dd, *J* = 6.0, 2.4 Hz, 1H), 7.58 – 7.53 (m, 2H), 7.51 (dd, *J* = 5.5, 2.6 Hz, 1H), 7.41 – 7.34 (m, 2H), 7.24 (dd, *J* = 5.2, 1.9 Hz, 3H), 5.74 (dd, *J* = 7.5, 4.0 Hz, 1H), 3.54 (dd, *J* = 13.0, 4.1 Hz, 1H), 3.23 (dd, *J* = 13.0, 7.6 Hz, 1H), 1.37 (s, 9H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 154.20 , 143.13 , 133.67 , 130.15 , 129.91 , 129.29 , 129.17 , 128.95 , 127.56 , 122.14 , 121.58 , 83.54 , 78.86 , 32.51 , 27.45 . HRMS (TOF) m/z [M + H]$^+$ Calcd for $C_{19}H_{22}NO_2Se$ 376.0810 found 376.0801.



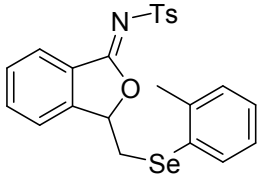
(Z)-3-((phenylselanyl)methyl)isobenzofuran-1(3H)-one O-benzyl oxime **(3x)**. White solid (84%, 0.103g). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.52 (dd, *J* = 5.6, 2.8 Hz, 1H), 7.40 – 7.28 (m, 5H), 7.26 – 7.13 (m, 5H), 7.07 (q, *J* = 6.2 Hz, 3H), 5.59 (dd, *J* = 7.0, 4.1 Hz, 1H), 5.03 (s, 2H), 3.36 (dd, *J* = 13.1, 4.2 Hz, 1H), 3.10 (dd, *J* = 13.1, 7.2 Hz, 1H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 155.99 , 143.37 , 137.99 , 133.59 , 130.68 , 129.26 , 129.14 , 128.49 , 128.38 , 127.86 , 127.62 , 122.19 , 121.81 , 83.97 , 76.83 , 32.38 . HRMS (TOF) m/z [M + H]$^+$ Calcd for $C_{22}H_{20}NO_2Se$ 410.0654 found 410.0659.



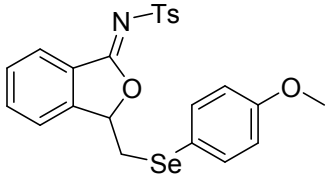
(Z)-N-methyl-3-((phenylselanyl)methyl)isobenzofuran-1(3H)-imine **(3y)**. Yellow oil (31%, 0.030g). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.66 (dt, *J* = 7.0, 3.7 Hz, 1H), 7.42 – 7.36 (m, 2H), 7.32 – 7.24 (m, 3H), 7.12 (dd, *J* = 4.9, 1.9 Hz, 3H), 5.54 (t, *J* = 5.5 Hz, 1H), 3.22 (d, *J* = 5.6 Hz, 2H), 2.99 (s, 3H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 159.63 , 145.17 , 133.31 , 131.10 , 129.67 , 129.13 , 129.05 , 127.39 , 123.00 , 121.74 , 81.68 , 34.33 , 32.77 . HRMS (TOF) m/z [M + H]$^{+}$ Calcd for $C_{16}H_{16}NOSe$ 318.0392 found 318.0399.



(Z)-4-methyl-N-(3-((p-tolylselanyl)methyl)isobenzofuran-1(3H)-ylidene)benzenesulfonamide **(3aa)**. White solid (78%, 0.110g). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.91 (d, *J* = 8.3 Hz, 2H), 7.83 (d, *J* = 7.3 Hz, 1H), 7.47 – 7.38 (m, 3H), 7.23 (d, *J* = 8.0 Hz, 4H), 6.96 (d, *J* = 7.9 Hz, 2H), 5.76 (dd, *J* = 6.8, 4.9 Hz, 1H), 3.27 (dd, *J* = 13.2, 4.8 Hz, 1H), 3.06 (dd, *J* = 13.2, 6.9 Hz, 1H), 2.34 (s, 3H), 2.24 (s, 3H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 166.00 , 145.68 , 142.39 , 137.40 , 137.21 , 133.23 , 133.16 , 129.13 , 128.78 , 128.17 , 126.82 , 125.45 , 124.50 , 123.67 , 121.20 , 85.18 , 30.33 , 20.57 , 20.10 . HRMS (TOF) m/z [M + H]$^{+}$ Calcd for $C_{23}H_{22}NO_3SSe$ 472.0480 found 472.0469.

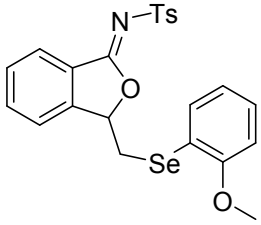


(Z)-4-methyl-N-(3-((o-tolylselanyl)methyl)isobenzofuran-1(3H)-ylidene)benzenesulfonamide **(3ab)**. White solid (70%, 0.099g). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.90 (d, *J* = 8.3 Hz, 2H), 7.79 (d, *J* = 7.2 Hz, 1H), 7.43 – 7.31 (m, 3H), 7.25 (d, *J* = 7.6 Hz, 1H), 7.19 (d, *J* = 8.1 Hz, 2H), 7.08 – 7.00 (m, 2H), 6.95 (td, *J* = 7.4, 2.0 Hz, 1H), 5.78 (dd, *J* = 6, 4.8 Hz, 1H), 3.25 (dd, *J* = 13.3, 4.7 Hz, 1H), 3.10 (dd, *J* = 13.3, 6.5 Hz, 1H), 2.31 (s, 3H), 2.19 (s, 3H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 166.04 , 145.55 , 142.45 , 139.23 , 137.32 , 133.25 , 132.45 , 129.16 , 128.79 , 128.58 , 128.16 , 126.95 , 126.81 , 125.74 , 125.37 , 124.37 , 121.07 , 85.23 , 29.19 , 21.52 , 20.56 . HRMS (TOF) m/z [M + H]$^{+}$ Calcd for $C_{23}H_{22}NO_3SSe$ 472.0480 found 472.0472.

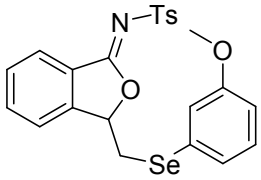


(Z)-N-(3-(((4-methoxyphenyl)selanyl)methyl)isobenzofuran-1(3H)-ylidene)-4-methylbenzenesulfonamide **(3ac)**. White solid (76%, 0.111g). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.91 (d, *J* = 8.3 Hz, 2H), 7.82 (d, *J* = 7.2 Hz, 1H), 7.48 – 7.32 (m, 3H), 7.22 (dd, *J* = 8.7, 2.6 Hz, 4H),

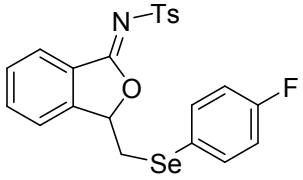
6.69 – 6.63 (m, 2H), 5.75 (dd, *J* = 6.4, 5.2 Hz, 1H), 3.70 (s, 3H), 3.19 (dd, *J* = 13.3, 4.8 Hz, 1H), 3.06 (dd, *J* = 13.3, 6.6 Hz, 1H), 2.34 (s, 3H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 166.09 , 158.88 , 145.65 , 142.42 , 137.31 , 135.44 , 133.18 , 128.77 , 128.33 , 128.16 , 126.82 , 124.44 , 121.14 , 117.43 , 113.96 , 85.18 , 54.33 , 30.95 , 20.59 . HRMS (TOF) m/z [M + H]$^+$ Calcd for $C_{23}H_{22}NO_4SSe$ 488.0429 found 488.0438.



(Z)-N-(3-(((2-methoxyphenyl)selanyl)methyl)isobenzofuran-1(3H)-ylidene)-4-methylbenzenesulfonamide **(3ad)**. White solid (69%, 0.101g). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.89 (d, *J* = 8.3 Hz, 2H), 7.77 (d, *J* = 7.4 Hz, 1H), 7.47 – 7.33 (m, 3H), 7.22 – 7.12 (m, 4H), 6.77 – 6.66 (m, 2H), 5.77 (dd, *J* = 7.1, 4.8 Hz, 1H), 3.77 (s, 3H), 3.37 (dd, *J* = 13.2, 4.7 Hz, 1H), 2.94 (dd, *J* = 13.2, 7.2 Hz, 1H), 2.30 (s, 3H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 166.18 , 157.52 , 145.83 , 142.41 , 137.28 , 133.19 , 132.99 , 128.75 , 128.46 , 128.14 , 128.03 , 126.80 , 124.28 , 121.39 , 120.38 , 115.82 , 109.78 , 85.62 , 54.85 , 27.38 , 20.57 . HRMS (TOF) m/z [M + H]$^+$ Calcd for $C_{23}H_{22}NO_4SSe$ 488.0429 found 488.0427.

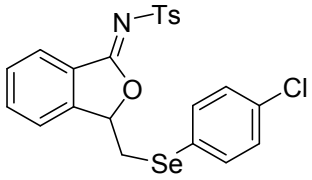


(Z)-N-(3-(((3-methoxyphenyl)selanyl)methyl)isobenzofuran-1(3H)-ylidene)-4-methylbenzenesulfonamide **(3ae)**. White solid (74%, 0.108g). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.94 – 7.89 (m, 2H), 7.81 (d, *J* = 6.6 Hz, 1H), 7.45 – 7.38 (m, 2H), 7.35 – 7.30 (m, 1H), 7.22 (d, *J* = 8.1 Hz, 2H), 7.05 (t, *J* = 7.9 Hz, 1H), 6.88 (d, *J* = 7.6 Hz, 1H), 6.80 – 6.76 (m, 1H), 6.73 – 6.68 (m, 1H), 5.80 (dd, *J* = 6.3, 4.8 Hz, 1H), 3.68 (s, 3H), 3.32 (dd, *J* = 13.3, 4.7 Hz, 1H), 3.14 (dd, *J* = 13.3, 6.6 Hz, 1H), 2.33 (s, 3H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 166.02 , 158.69 , 145.47 , 142.45 , 137.27 , 133.11 , 129.06 , 128.78 , 128.45 , 128.30 , 128.16 , 126.84 , 124.76 , 124.40 , 121.17 , 118.07 , 112.69 , 85.06 , 54.31 , 30.26 , 20.57 . HRMS (TOF) m/z [M + H]$^+$ Calcd for $C_{23}H_{22}NO_4SSe$ 488.0429 found 488.0432.

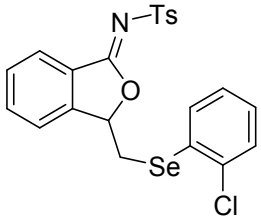


(Z)-N-(3-(((4-fluorophenyl)selanyl)methyl)isobenzofuran-1(3H)-ylidene)-4-methylbenzenesulfonamide **(3af)**. White solid (83%, 0.119g). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.92 (d, *J* = 7.7 Hz, 2H), 7.84 (d, *J* = 5.2 Hz, 1H), 7.42 (q, *J* = 7.9, 5.8 Hz, 2H), 7.26 (dt, *J* = 12.6, 6.5 Hz, 5H), 6.82 (t, *J* = 8.3 Hz, 2H), 5.82 (t, *J* = 5.2 Hz, 1H), 3.27 (dd, *J* = 13.4, 4.4 Hz, 1H), 3.18 (dd, *J* = 13.4, 6.1 Hz, 1H), 2.35 (s, 3H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 165.94 , 161.75 (d, *J* = 247 Hz) , 145.31 , 142.47 , 137.25 , 135.46 (d, *J* = 8 Hz) , 133.16 , 128.84 , 128.45 , 128.17 , 126.79 , 124.48 ,

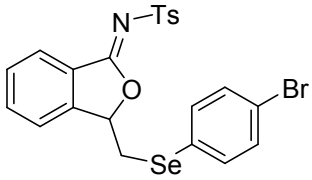
122.13 (d, *J* = 4 Hz) , 120.92 , 115.43 (d, *J* = 21 Hz) , 84.89 , 31.18 , 20.59 . ^{19}F NMR (376 MHz, Chloroform-*d*) δ -112.95 . HRMS (TOF) m/z [M + H]$^+$ Calcd for $C_{22}H_{19}FNO_3SSe$ 476.0229 found 476.0235.



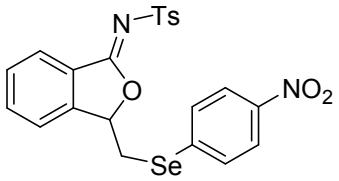
(Z)-N-(3-(((4-chlorophenyl)selanyl)methyl)isobenzofuran-1(3H)-ylidene)-4-methylbenzenesulfonamide **(3ag)**. White solid (80%, 0.118g). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.92 (d, *J* = 8.0 Hz, 2H), 7.83 (s, 1H), 7.47 – 7.39 (m, 2H), 7.29 – 7.21 (m, 3H), 7.21 – 7.17 (m, 2H), 7.08 (d, *J* = 8.2 Hz, 2H), 5.83 (t, *J* = 5.2 Hz, 1H), 3.30 (dd, *J* = 13.5, 4.5 Hz, 1H), 3.21 (dd, *J* = 13.5, 6.0 Hz, 1H), 2.35 (s, 3H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 165.86 , 145.26 , 142.47 , 137.33 , 134.29 , 133.29 , 133.20 , 128.89 , 128.45 , 128.38 , 128.19 , 126.79 , 125.83 , 124.51 , 120.92 , 84.86 , 30.89 , 20.59 . HRMS (TOF) m/z [M + H]$^+$ Calcd for $C_{22}H_{19}ClNO_3SSe$ 491.9934 found 491.9941.



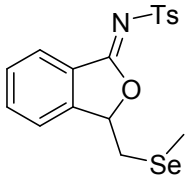
(Z)-N-(3-(((2-chlorophenyl)selanyl)methyl)isobenzofuran-1(3H)-ylidene)-4-methylbenzenesulfonamide **(3ah)**. White solid (73%, 0.107g). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.90 (d, *J* = 8.3 Hz, 2H), 7.80 (d, *J* = 7.3 Hz, 1H), 7.45 – 7.35 (m, 3H), 7.26 – 7.18 (m, 4H), 7.09 (td, *J* = 7.7, 1.6 Hz, 1H), 7.01 (td, *J* = 7.6, 1.4 Hz, 1H), 5.84 (dd, *J* = 6, 5.2 Hz, 1H), 3.41 (dd, *J* = 13.4, 4.7 Hz, 1H), 3.15 (dd, *J* = 13.4, 6.5 Hz, 1H), 2.31 (s, 3H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 165.90 , 145.35 , 142.51 , 137.21 , 135.57 , 133.31 , 132.61 , 128.92 , 128.70 , 128.18 , 127.85 , 126.81 , 126.46 , 124.48 , 121.07 , 84.97 , 28.86 , 20.57 . HRMS (TOF) m/z [M + H]$^+$ Calcd for $C_{22}H_{19}ClNO_3SSe$ 491.9934 found 491.9932.



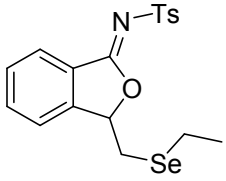
(Z)-N-(3-(((4-bromophenyl)selanyl)methyl)isobenzofuran-1(3H)-ylidene)-4-methylbenzenesulfonamide **(3ai)**. White solid (81%, 0.130g). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.88 (d, *J* = 8.3 Hz, 2H), 7.80 – 7.73 (m, 1H), 7.37 (dt, *J* = 7.4, 3.5 Hz, 2H), 7.25 – 7.12 (m, 5H), 7.09 – 7.04 (m, 2H), 5.84 (t, *J* = 5.0 Hz, 1H), 3.30 – 3.20 (m, 2H), 2.30 (s, 3H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 167.09 , 146.28 , 143.57 , 138.28 , 135.38 , 134.33 , 132.22 , 129.90 , 129.32 , 129.25 , 127.82 , 127.78 , 125.31 , 122.16 , 122.09 , 86.08 , 31.96 , 21.64 . HRMS (TOF) m/z [M + H]$^+$ Calcd for $C_{22}H_{19}BrNO_3SSe$ 535.9429 found 535.9438.



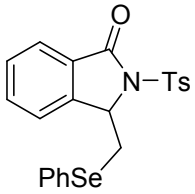
(Z)-4-methyl-N-(3-(((4-nitrophenyl)selanyl)methyl)isobenzofuran-1(3H)-ylidene)benzenesulfonamide **(3aj)**. White solid (51%, 0.077g). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.99 – 7.93 (m, 2H), 7.89 (d, *J* = 8.3 Hz, 2H), 7.83 (d, *J* = 5.5 Hz, 1H), 7.44 (ddt, *J* = 9.0, 7.4, 1.9 Hz, 4H), 7.29 (dd, *J* = 5.7, 2.4 Hz, 1H), 7.23 (d, *J* = 8.3 Hz, 2H), 5.96 (t, *J* = 5.0 Hz, 1H), 3.47 (dd, *J* = 5.0, 1.8 Hz, 2H), 2.34 (s, 3H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 165.52 , 145.92 , 144.93 , 142.56 , 138.04 , 137.30 , 133.36 , 131.35 , 129.13 , 128.49 , 128.24 , 126.65 , 124.62 , 122.93 , 120.75 , 84.63 , 30.33 , 20.58 . HRMS (TOF) m/z [M + H]$^{+}$ Calcd for $C_{22}H_{19}N_2O_5SSe$ 503.0174 found 503.0178.



(Z)-4-methyl-N-(3-((methylselanyl)methyl)isobenzofuran-1(3H)-ylidene)benzenesulfonamide (**3ak**). White solid (78%, 0.092g). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.89 (d, *J* = 8.3 Hz, 2H), 7.81 (d, *J* = 7.7 Hz, 1H), 7.58 (td, *J* = 7.6, 1.0 Hz, 1H), 7.50 – 7.42 (m, 2H), 7.22 (d, *J* = 8.1 Hz, 2H), 5.89 (t, *J* = 5.3 Hz, 1H), 2.95 (d, *J* = 5.4 Hz, 2H), 2.33 (s, 3H), 1.91 (s, 3H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 167.17 , 147.02 , 143.42 , 138.48 , 134.53 , 129.87 , 129.47 , 129.23 , 127.64 , 125.47 , 121.92 , 87.43 , 28.15 , 21.59 , 6.32 . HRMS (TOF) m/z [M + H]$^{+}$ Calcd for $C_{17}H_{18}NO_3SSe$ 396.0167 found 396.0172.

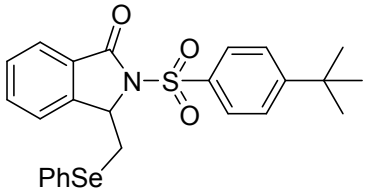


(Z)-N-(3-((ethylselanyl)methyl)isobenzofuran-1(3H)-ylidene)-4-methylbenzenesulfonamide (**3al**). White solid (75%, 0.092g). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.89 (d, *J* = 8.3 Hz, 2H), 7.82 (d, *J* = 7.7 Hz, 1H), 7.62 – 7.56 (m, 1H), 7.52 – 7.42 (m, 2H), 7.22 (d, *J* = 8.1 Hz, 2H), 5.88 (t, *J* = 5.5 Hz, 1H), 3.01 (dd, *J* = 13.6, 5.0 Hz, 1H), 2.92 (dd, *J* = 13.5, 6.2 Hz, 1H), 2.52 (qd, *J* = 7.5, 2.4 Hz, 2H), 2.34 (s, 3H), 1.26 (t, *J* = 7.5 Hz, 3H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 166.11 , 146.12 , 142.35 , 137.50 , 133.45 , 128.83 , 128.43 , 128.20 , 126.61 , 124.50 , 120.89 , 86.47 , 24.93 , 20.56 , 18.27 , 14.64 . HRMS (TOF) m/z [M + H]$^{+}$ Calcd for $C_{18}H_{20}NO_3SSe$ 410.0324 found 410.0329.

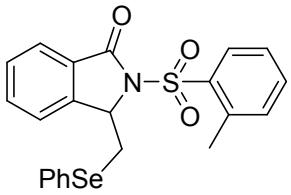


3-((phenylselanyl)methyl)-2-tosylisoindolin-1-one (**4a**). White solid (54%, 0.074g). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.93 (s, 2H), 7.71 (d, *J* = 7.2 Hz, 1H), 7.32 (ddd, *J* = 9.1, 5.3, 2.2 Hz, 1H), 7.29

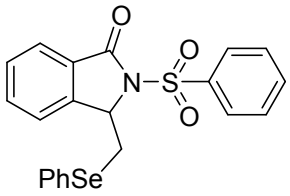
– 7.26 (m, 2H), 7.23 (d, *J* = 8.1 Hz, 2H), 7.16 – 7.08 (m, 3H), 7.07 – 7.01 (m, 2H), 5.44 (dd, *J* = 6.1, 2.5 Hz, 1H), 3.73 (dd, *J* = 13.2, 2.5 Hz, 1H), 3.63 (dd, *J* = 13.2, 6.2 Hz, 1H), 2.33 (s, 3H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 165.43 , 144.14 , 143.16 , 134.79 , 132.49 , 132.26 , 128.89 , 128.64 , 128.27 , 128.12 , 127.92 , 127.20 , 126.29 , 123.67 , 122.22 , 59.89 , 31.84 , 20.68 . HRMS (TOF) m/z [M + H]$^+$ Calcd for $C_{22}H_{20}NO_3SSe$ 458.0324 found 458.0321.



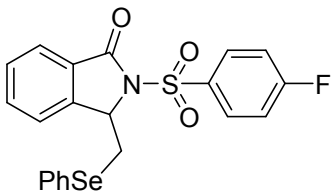
2-((4-(tert-butyl)phenyl)sulfonyl)-3-((phenylselanyl)methyl)isoindolin-1-one (**4b**). White solid (58%, 0.087g). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.97 – 7.93 (m, 2H), 7.70 (dd, *J* = 7.0, 1.3 Hz, 1H), 7.45 – 7.41 (m, 2H), 7.33 – 7.26 (m, 3H), 7.15 (dd, *J* = 8.2, 1.3 Hz, 2H), 7.12 – 7.07 (m, 1H), 7.06 – 7.01 (m, 2H), 5.44 (dd, *J* = 6.2, 2.4 Hz, 1H), 3.74 (dd, *J* = 13.1, 2.5 Hz, 1H), 3.63 (dd, *J* = 13.1, 6.2 Hz, 1H), 1.22 (s, 9H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 165.44 , 156.93 , 143.22 , 134.73 , 132.51 , 132.23 , 128.90 , 128.30 , 128.12 , 127.93 , 127.02 , 126.28 , 125.05 , 123.63 , 122.27 , 59.94 , 34.24 , 31.85 , 29.96 . HRMS (TOF) m/z [M + H]$^+$ Calcd for $C_{25}H_{26}NO_3SSe$ 500.0793 found 500.0798.



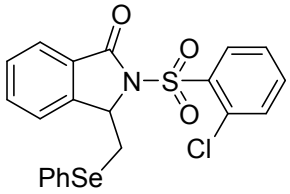
3-((phenylselanyl)methyl)-2-(o-tolylsulfonyl)isoindolin-1-one (**4c**). White solid (51%, 0.070g). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.12 (dd, *J* = 8.0, 1.2 Hz, 1H), 7.71 – 7.66 (m, 1H), 7.44 – 7.39 (m, 2H), 7.38 – 7.32 (m, 2H), 7.31 (d, *J* = 7.6 Hz, 1H), 7.29 – 7.25 (m, 2H), 7.17 (s, 1H), 7.15 – 7.06 (m, 3H), 5.49 (dd, *J* = 6.9, 2.5 Hz, 1H), 3.88 (dd, *J* = 13.1, 2.5 Hz, 1H), 3.57 (dd, *J* = 13.1, 6.9 Hz, 1H), 2.48 (s, 3H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 165.07 , 143.23 , 136.97 , 135.96 , 132.99 , 132.57 , 132.28 , 131.50 , 130.33 , 128.58 , 128.25 , 128.14 , 128.00 , 126.35 , 125.36 , 123.81 , 122.50 , 60.30 , 32.06 , 19.44 . HRMS (TOF) m/z [M + H]$^+$ Calcd for $C_{22}H_{20}NO_3SSe$ 458.0324 found 458.0327.



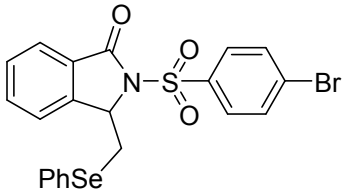
3-((phenylselanyl)methyl)-2-(phenylsulfonyl)isoindolin-1-one (**4d**). White solid (51%, 0.068g). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.08 – 8.02 (m, 2H), 7.72 (d, *J* = 7.3 Hz, 1H), 7.55 (t, *J* = 7.4 Hz, 1H), 7.45 (t, *J* = 7.7 Hz, 2H), 7.36 – 7.26 (m, 3H), 7.17 – 7.09 (m, 3H), 7.04 (t, *J* = 7.3 Hz, 2H), 5.46 (dd, *J* = 6.0, 2.5 Hz, 1H), 3.73 (dd, *J* = 13.2, 2.5 Hz, 1H), 3.64 (dd, *J* = 13.2, 6.1 Hz, 1H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 165.41 , 143.14 , 137.74 , 133.03 , 132.57 , 132.30 , 128.80 , 128.20 , 128.17 , 128.04 , 127.94 , 127.14 , 126.34 , 123.73 , 122.22 , 59.95 , 31.84 . HRMS (TOF) m/z [M + H]$^+$ Calcd for $C_{21}H_{18}NO_3SSe$ 444.0167 found 444.0169.



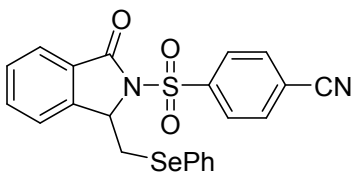
2-((4-fluorophenyl)sulfonyl)-3-((phenylselanyl)methyl)isoindolin-1-one (**4e**). White solid (47%, 0.065g). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.07 (ddd, *J* = 9.0, 5.0, 2.5 Hz, 2H), 7.71 (d, *J* = 7.0 Hz, 1H), 7.36 – 7.23 (m, 3H), 7.10 (dtd, *J* = 8.2, 5.8, 5.0, 2.2 Hz, 5H), 7.06 – 7.00 (m, 2H), 5.46 (dd, *J* = 5.6, 2.7 Hz, 1H), 3.70 (dd, *J* = 13.2, 2.7 Hz, 1H), 3.65 (dd, *J* = 13.2, 5.6 Hz, 1H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 165.44 , 164.87 (d, *J* = 255 Hz) , 143.06 , 133.69 (d, *J* = 3 Hz) , 132.71 , 132.22 , 130.16 (d, *J* = 10 Hz) , 128.66 , 128.25 , 128.16 , 127.96 , 126.36 , 123.69 , 122.19 , 115.31 (d, *J* = 23 Hz) , 59.96 , 31.77 . ^{19}F NMR (376 MHz, Chloroform-*d*) δ -102.52 . HRMS (TOF) m/z [M + H]$^{+}$ Calcd for $C_{21}H_{17}FNO_3SSe$ 462.0073 found 462.0077.



2-((2-chlorophenyl)sulfonyl)-3-((phenylselanyl)methyl)isoindolin-1-one (**4f**). White solid (50%, 0.071g). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.34 (dd, *J* = 7.5, 2.1 Hz, 1H), 7.66 (dd, *J* = 6.3, 2.2 Hz, 1H), 7.50 – 7.42 (m, 3H), 7.41 – 7.37 (m, 1H), 7.37 – 7.30 (m, 4H), 7.17 – 7.07 (m, 3H), 5.70 (dd, *J* = 7.0, 2.4 Hz, 1H), 3.92 (dd, *J* = 13.1, 2.5 Hz, 1H), 3.61 (dd, *J* = 13.1, 7.1 Hz, 1H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 164.92 , 143.62 , 134.95 , 133.95 , 132.97 , 132.76 , 132.31 , 130.84 , 130.56 , 128.19 , 128.15 , 128.01 , 126.35 , 126.16 , 123.80 , 122.56 , 61.05 , 32.12 . HRMS (TOF) m/z [M + H]$^{+}$ Calcd for $C_{21}H_{17}ClNO_3SSe$ 477.9777 found 477.9772.

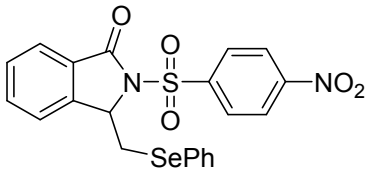


2-((4-bromophenyl)sulfonyl)-3-((phenylselanyl)methyl)isoindolin-1-one (**4g**). White solid (52%, 0.081g). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.93 – 7.87 (m, 2H), 7.73 (d, *J* = 6.8 Hz, 1H), 7.60 – 7.54 (m, 2H), 7.38 – 7.25 (m, 3H), 7.12 (dt, *J* = 7.2, 2.5 Hz, 3H), 7.08 – 7.01 (m, 2H), 5.46 (dd, *J* = 5.8, 2.4 Hz, 1H), 3.72 (dd, *J* = 13.2, 2.5 Hz, 1H), 3.64 (dd, *J* = 13.2, 5.9 Hz, 1H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 165.42 , 143.09 , 136.62 , 132.77 , 132.24 , 131.32 , 128.68 , 128.60 , 128.39 , 128.30 , 128.13 , 127.99 , 126.39 , 123.78 , 122.19 , 59.96 , 31.72 . HRMS (TOF) m/z [M + H]$^{+}$ Calcd for $C_{21}H_{17}BrNO_3SSe$ 521.9272 found 521.9278.

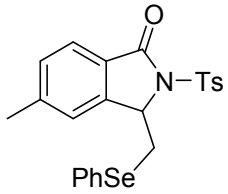


4-((1-oxo-3-((phenylselanyl)methyl)isoindolin-2-yl)sulfonyl)benzonitrile **(4h)**. White solid (45%, 0.063g). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.16 (d, *J* = 8.4 Hz, 2H), 7.72 (t, *J* = 8.4 Hz, 3H), 7.35

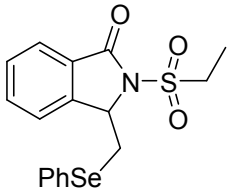
(dt, *J* = 14.9, 7.2 Hz, 2H), 7.26 (d, *J* = 7.3 Hz, 1H), 7.17 – 7.01 (m, 5H), 5.51 (dd, *J* = 4.5, 2.6 Hz, 1H), 3.73 – 3.62 (m, 2H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 165.39 , 143.01 , 141.52 , 133.04 , 132.11 , 131.75 , 128.46 , 128.30 , 128.04 , 127.83 , 126.48 , 123.88 , 122.17 , 116.59 , 116.11 , 60.06 , 31.61 . HRMS (TOF) m/z [M + H]$^+$ Calcd for $C_{22}H_{17}N_2O_3SSe$ 469.0120 found 469.0111.



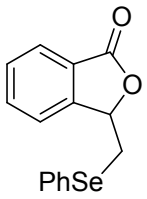
2-((4-nitrophenyl)sulfonyl)-3-((phenylselanyl)methyl)isoindolin-1-one **(4i)**. White solid (34%, 0.050g). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.24 (s, 4H), 7.74 (dd, *J* = 6.5, 1.6 Hz, 1H), 7.36 (pd, *J* = 7.3, 1.2 Hz, 2H), 7.29 – 7.25 (m, 1H), 7.12 (ddt, *J* = 7.4, 6.2, 1.7 Hz, 1H), 7.10 – 7.01 (m, 4H), 5.53 (dd, *J* = 5.1, 2.8 Hz, 1H), 3.74 – 3.64 (m, 2H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 165.39 , 149.69 , 143.01 , 142.96 , 133.11 , 132.08 , 128.60 , 128.49 , 128.26 , 128.04 , 127.99 , 126.50 , 123.91 , 123.17 , 122.16 , 60.08 , 31.61 . HRMS (TOF) m/z [M + H]$^+$ Calcd for $C_{21}H_{18}N_2O_5SSe$ 489.0018 found 489.0010.



5-methyl-3-((phenylselanyl)methyl)-2-tosylisoindolin-1-one (**4j**). White solid (55%, 0.078g). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.91 (d, *J* = 8.4 Hz, 2H), 7.56 (d, *J* = 7.9 Hz, 1H), 7.21 (d, *J* = 8.2 Hz, 2H), 7.10 – 7.05 (m, 4H), 7.03 – 6.97 (m, 2H), 6.93 (s, 1H), 5.40 (dd, *J* = 5.4, 2.4 Hz, 1H), 3.69 (dd, *J* = 13.3, 5.5 Hz, 1H), 3.63 (dd, *J* = 13.3, 2.5 Hz, 1H), 2.31 (s, 3H), 2.11 (s, 3H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 165.49 , 144.02 , 143.86 , 143.29 , 134.93 , 132.38 , 129.23 , 128.61 , 128.34 , 127.73 , 127.10 , 126.41 , 126.29 , 123.37 , 122.66 , 59.86 , 32.06 , 20.93 , 20.66 . HRMS (TOF) m/z [M + H]$^+$ Calcd for $C_{23}H_{22}NO_3SSe$ 472.0480 found 472.0485.



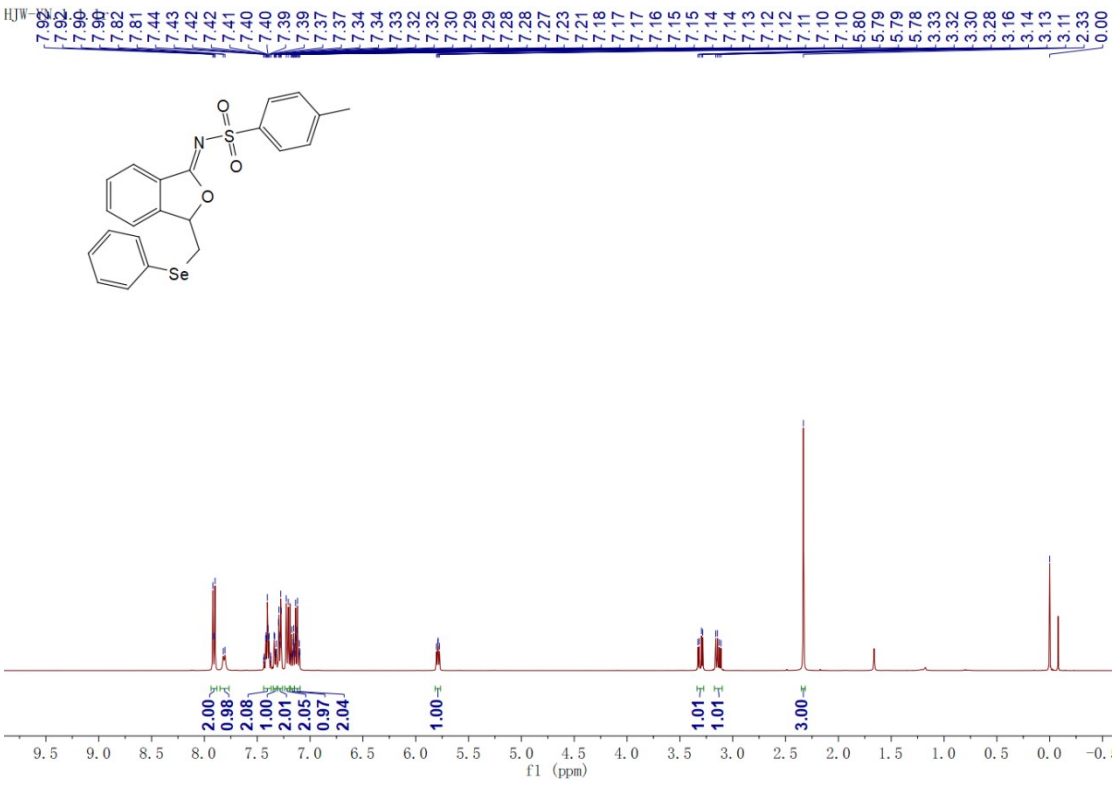
2-(ethylsulfonyl)-3-((phenylselanyl)methyl)isoindolin-1-one (**4k**). White solid (55%, 0.064g). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.81 (dd, *J* = 5.7, 2.8 Hz, 1H), 7.44 – 7.32 (m, 3H), 7.24 – 7.20 (m, 2H), 7.15 – 7.04 (m, 3H), 5.44 (dd, *J* = 5.8, 2.6 Hz, 1H), 3.69 (dd, *J* = 13.2, 2.7 Hz, 1H), 3.65 – 3.56 (m, 2H), 3.35 (dd, *J* = 14.3, 7.3 Hz, 1H), 1.33 (t, *J* = 7.4 Hz, 3H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 166.62 , 143.61 , 132.84 , 132.15 , 128.67 , 128.31 , 128.16 , 128.07 , 126.39 , 123.84 , 122.29 , 59.34 , 47.92 , 31.48 , 6.38 . HRMS (TOF) m/z [M + H]$^+$ Calcd for $C_{17}H_{18}NO_3SSe$ 396.0167 found 396.0169.

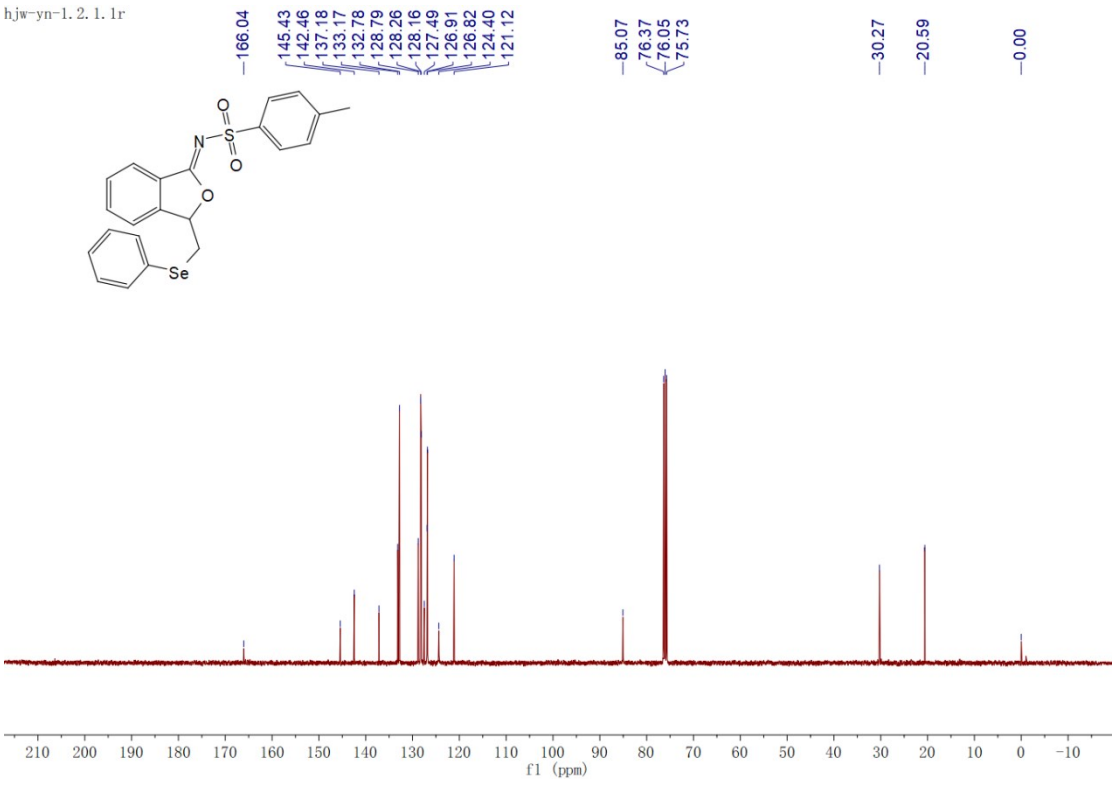


3-((phenylselanyl)methyl)isobenzofuran-1(3H)-one **(5)**. Colorless oil (88%, 0.133g). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.74 (d, *J* = 7.4 Hz, 1H), 7.42 (td, *J* = 7.4, 1.3 Hz, 1H), 7.39 – 7.33 (m, 2H), 7.33 – 7.28 (m, 2H), 7.13 – 7.04 (m, 3H), 5.51 (t, *J* = 5.5 Hz, 1H), 3.30 (dd, *J* = 13.3, 5.1 Hz, 1H), 3.22 (dd, *J* = 13.3, 5.9 Hz, 1H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 170.02 , 148.54 , 133.99 , 133.53 , 129.53 , 129.26 , 129.21 , 127.69 , 126.50 , 125.50 , 122.54 , 79.15 , 31.92 . HRMS (TOF) m/z $[M + H]^+$ Calcd for $C_{15}H_{13}O_2Se$ 305.0075 found 305.0080.

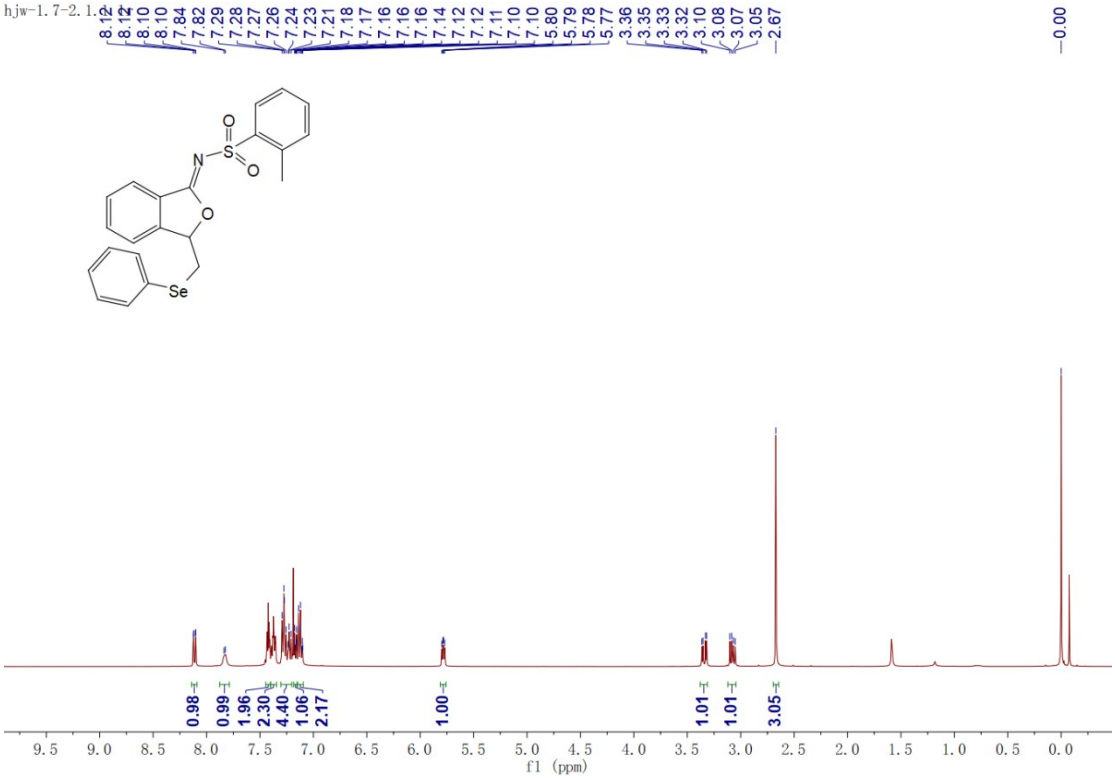
11. ^{1}H NMR, ^{13}C NMR and ^{19}F NMR spectra

Product **3a**





Product **3b**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3.32
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3.07
3.05
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S
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Se
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2.30
4.40
1.06
2.17
1.00
1.01
1.01
3.05
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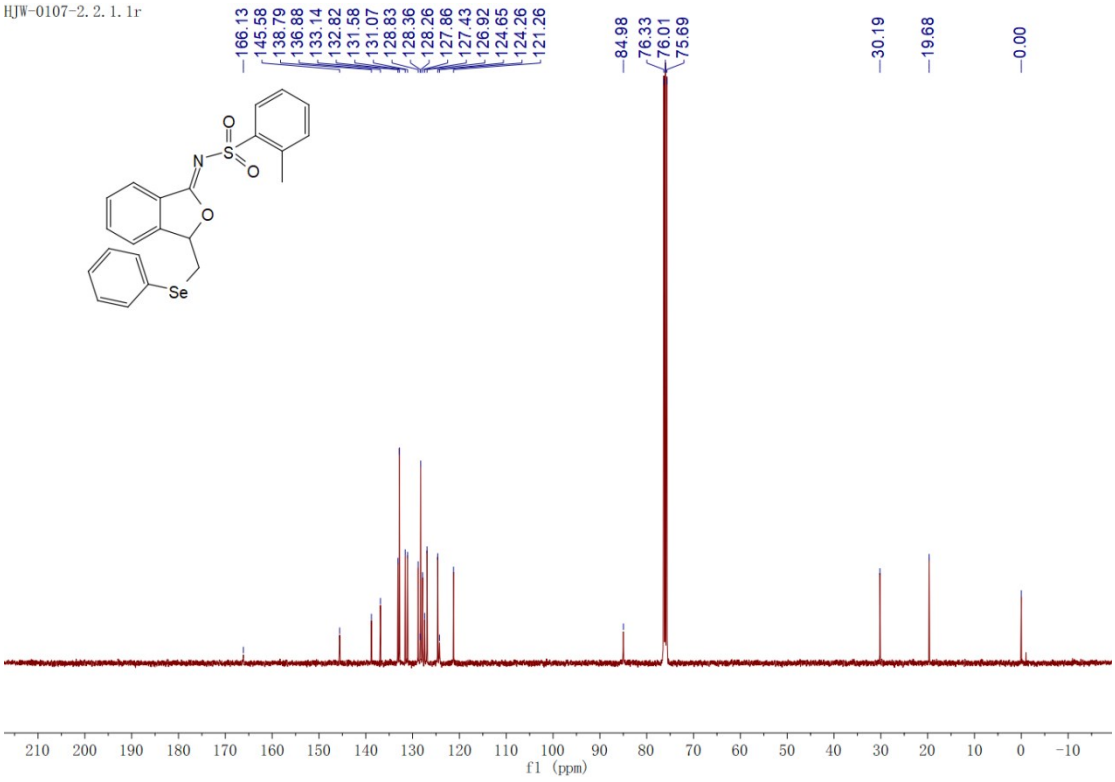
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19.68
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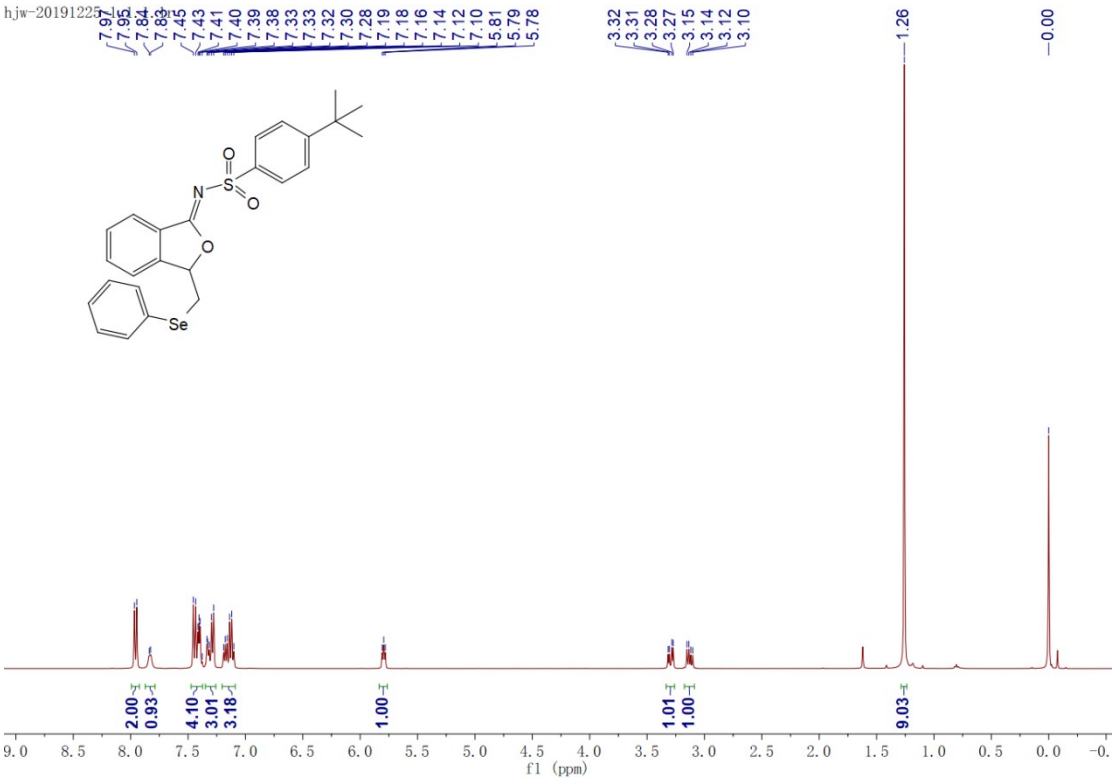
f1 (ppm)

Product **3c**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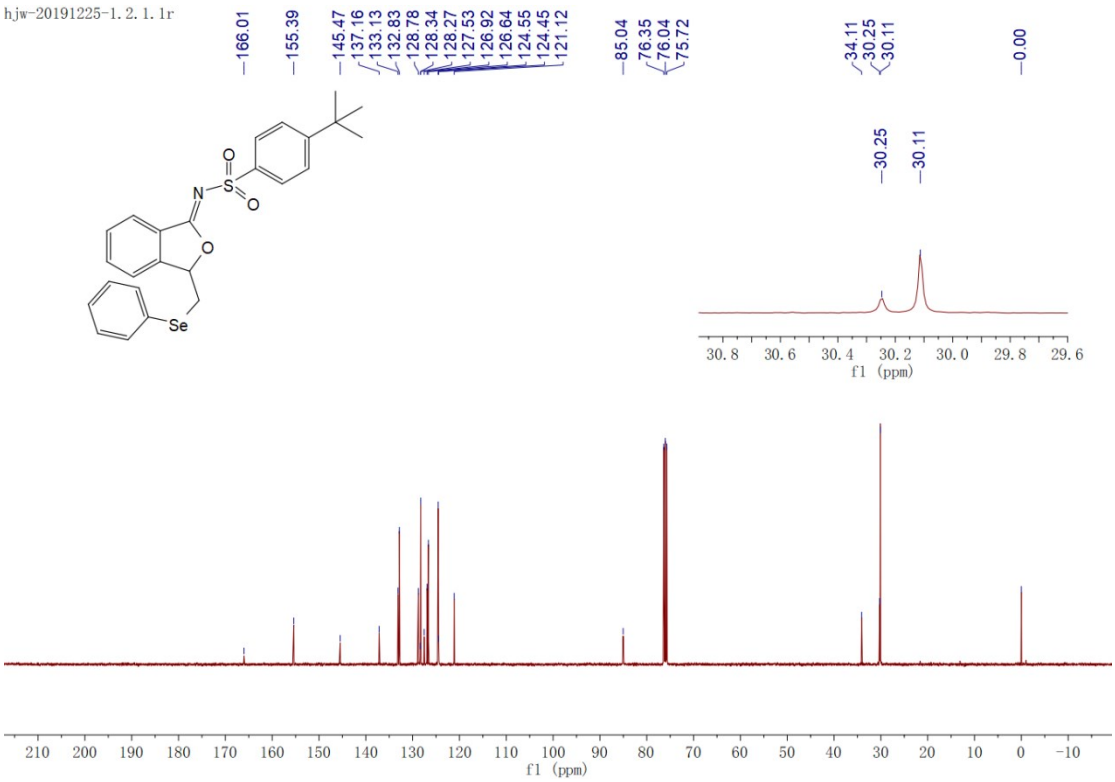
f1 (ppm)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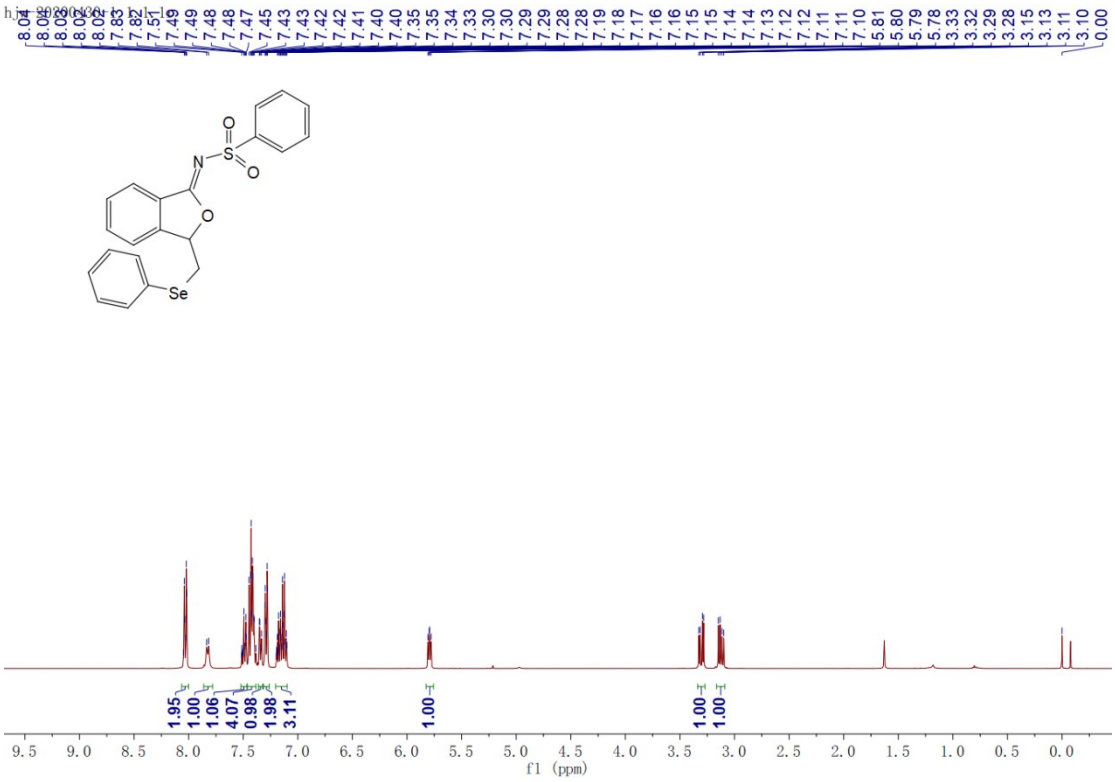
O
Se
f1 (ppm)
f1 (ppm)

Product **3d**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O
S
N
O
O
Se
1.95 1.00 1.06 4.07 0.98 1.98 3.11 1.00 1.00 1.00
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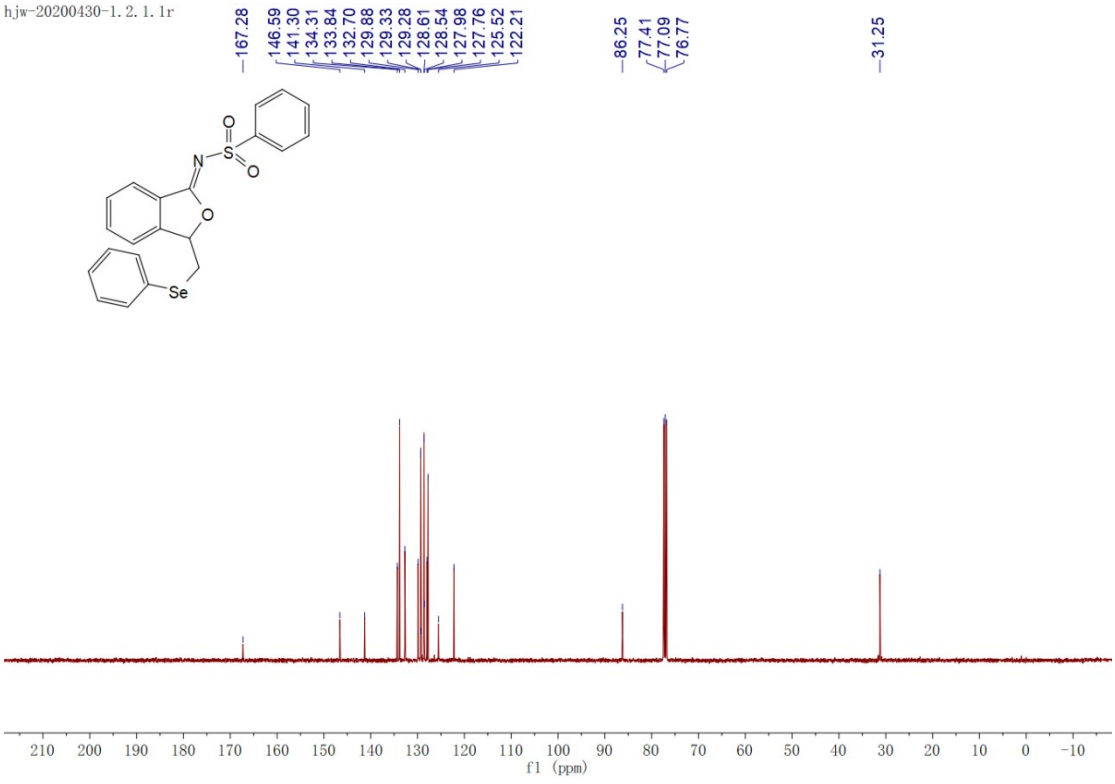
f1 (ppm)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31.25
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O
O
Se
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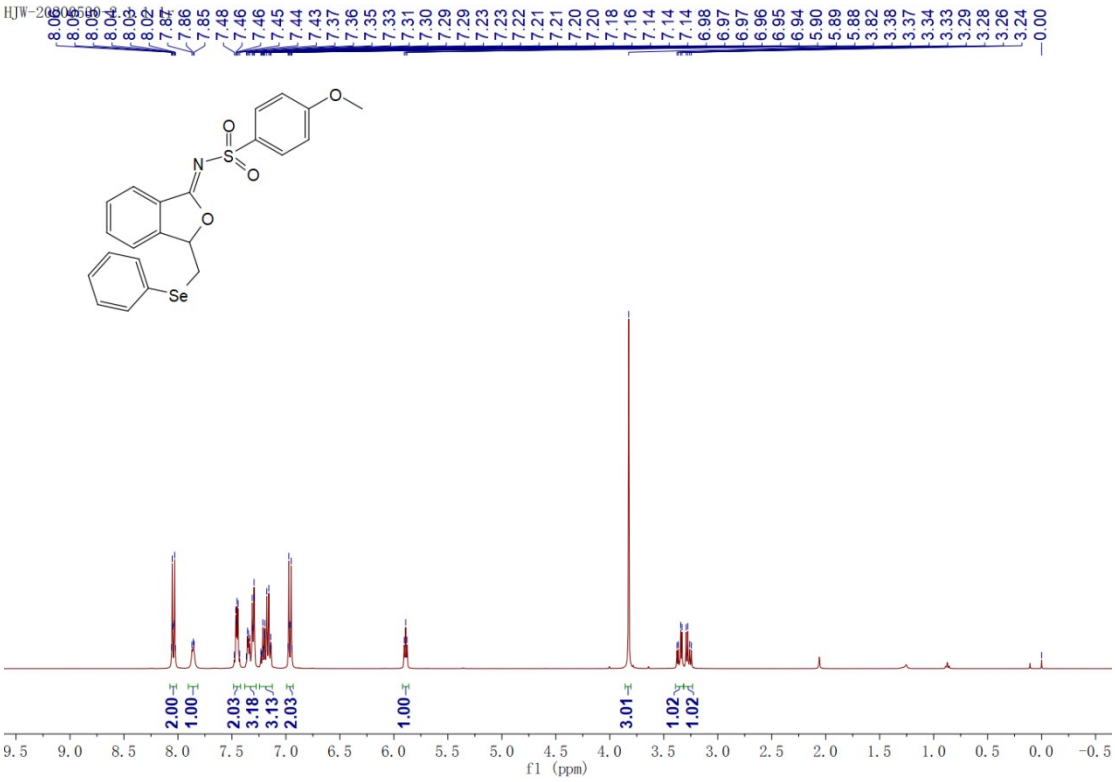
f1 (ppm)

Product **3e**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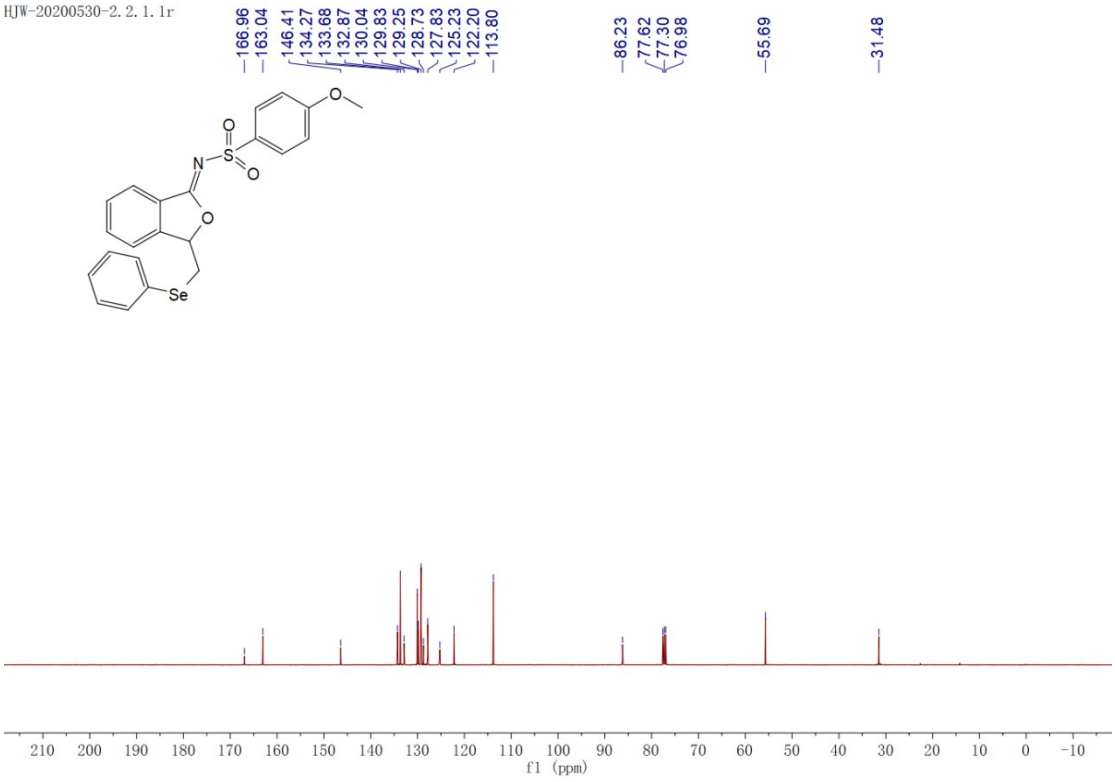
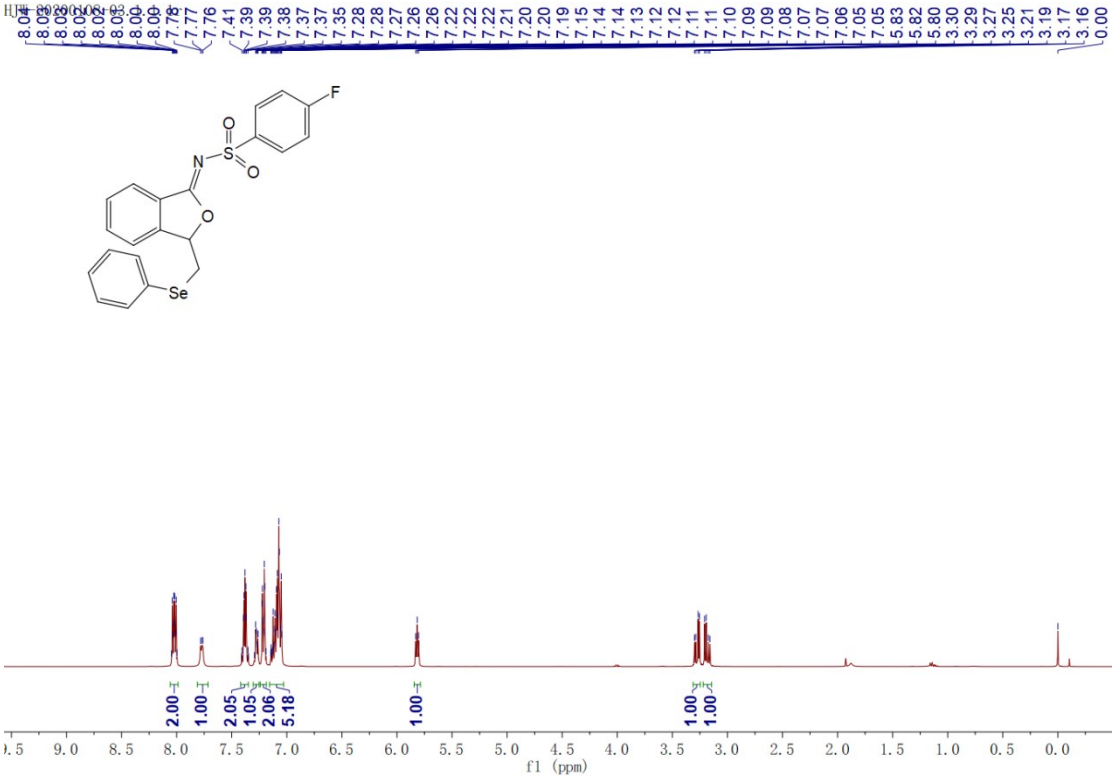
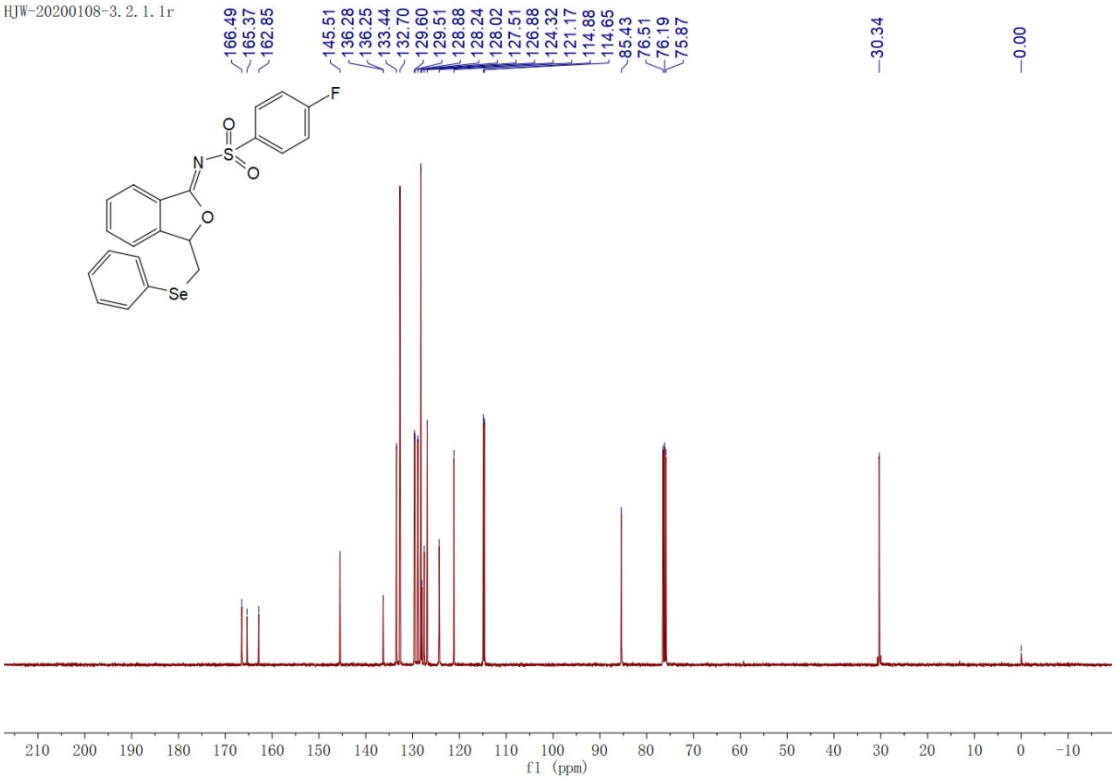
1.02
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

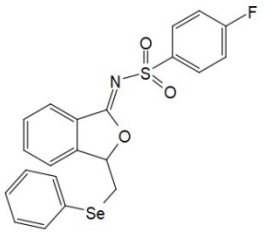

HJW-20200530-2.2.1.1r
166.96
163.04
146.41
134.27
133.68
132.87
130.04
129.83
129.25
128.73
127.83
125.23
122.20
113.80
86.23
77.62
77.30
76.98
55.69
31.48
O
O
N
S
O
O
Se
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

Product **3f**

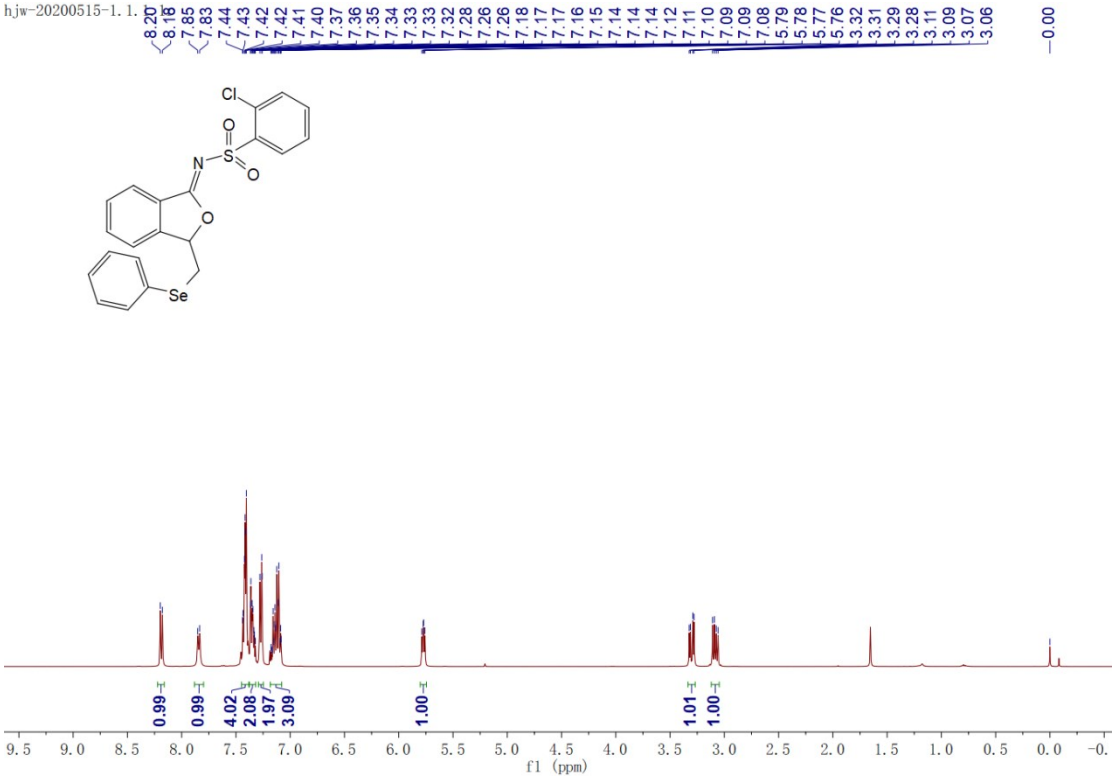

F
O
S
N
O
O
Se
2.00
1.00
2.05
1.05
2.06
5.18
1.00
1.00
1.00
f1 (ppm)

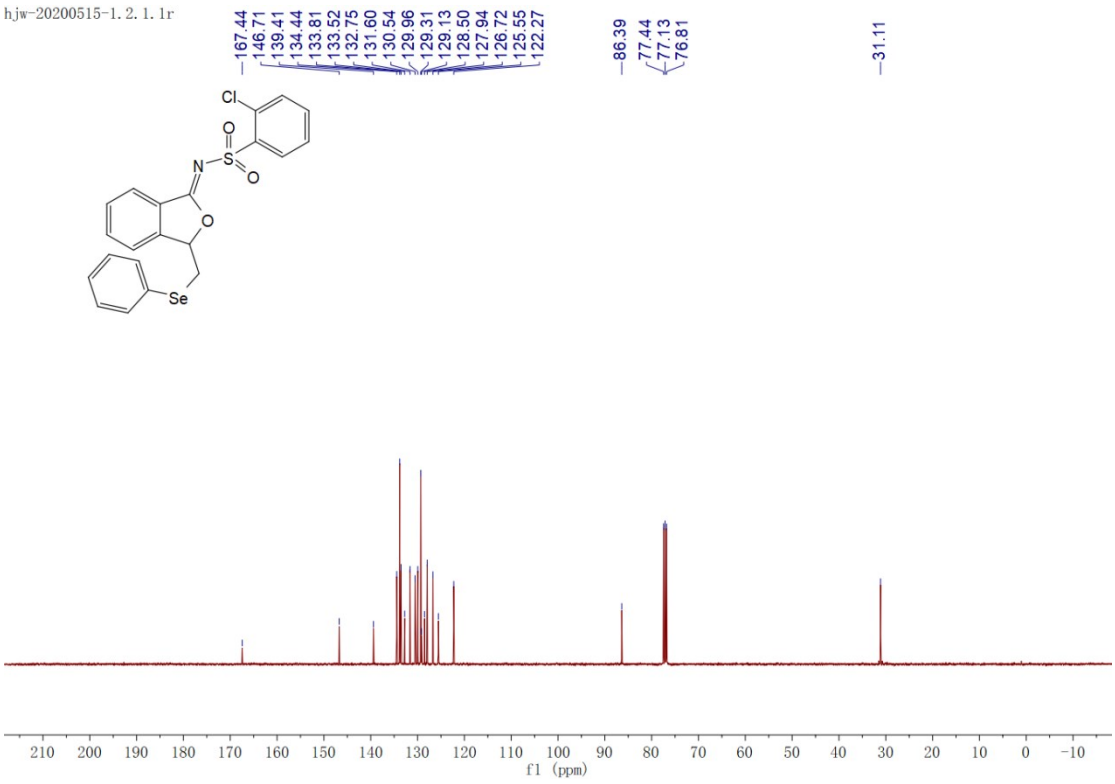

HJW-20200108-3.2.1.1r
166.49
165.37
162.85
145.51
136.28
136.25
133.44
132.70
129.60
129.51
128.88
128.24
128.02
127.51
126.88
124.32
121.17
114.88
114.65
85.43
76.51
76.19
75.87
30.34
0.00
F
O
S
N
O
O
Se
f1 (ppm)

HJW-20200108-3.7.1.1r

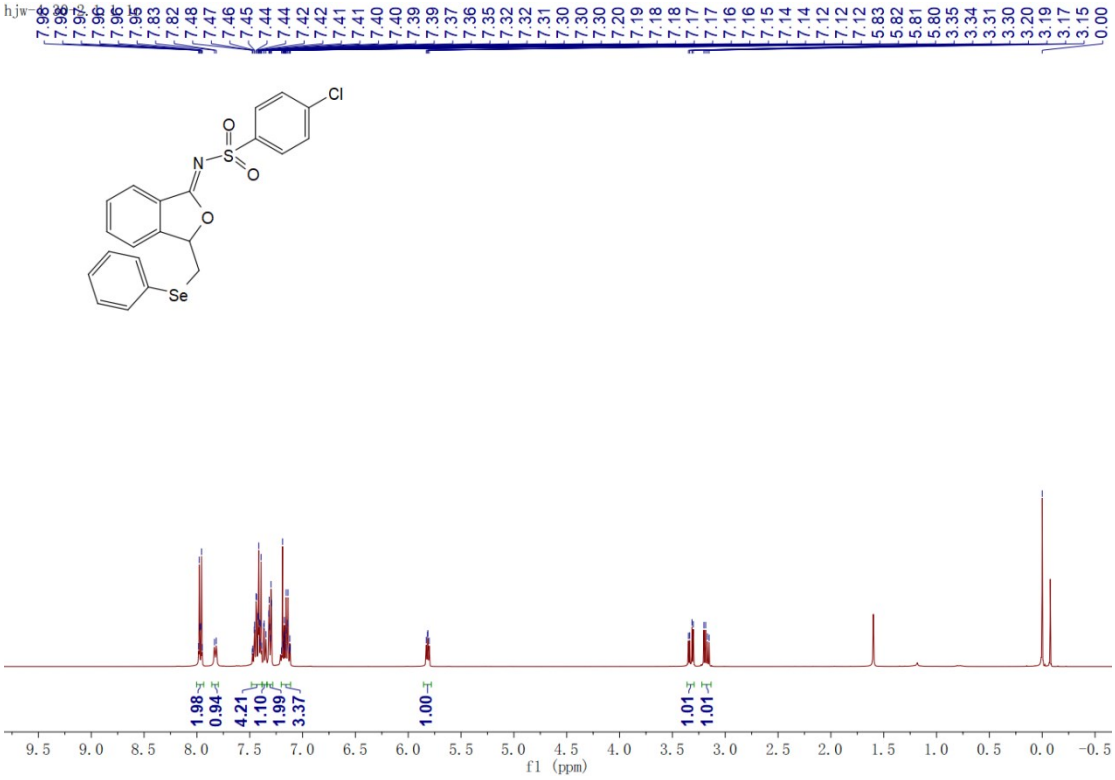


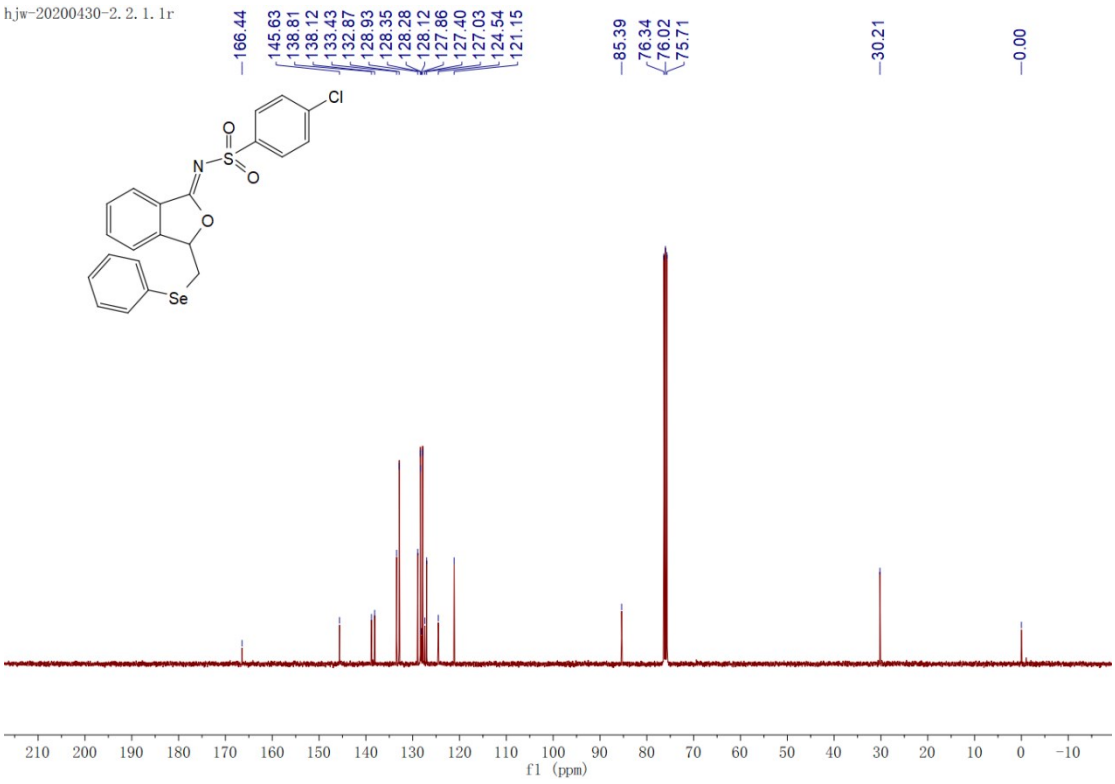
Product **3g**


hjw-20200515-1.1.1r
8.20
8.18
7.85
7.83
7.44
7.43
7.42
7.42
7.41
7.40
7.37
7.36
7.35
7.34
7.33
7.33
7.32
7.28
7.26
7.26
7.18
7.17
7.17
7.16
7.15
7.14
7.14
7.14
7.12
7.11
7.10
7.09
7.09
7.08
5.79
5.78
5.77
5.76
3.32
3.31
3.29
3.28
3.11
3.09
3.07
3.06
0.00
Cl
O
N
S
O
O
Se
0.99
0.99
4.02
2.08
1.97
3.09
1.00
1.01
1.00
f1 (ppm)

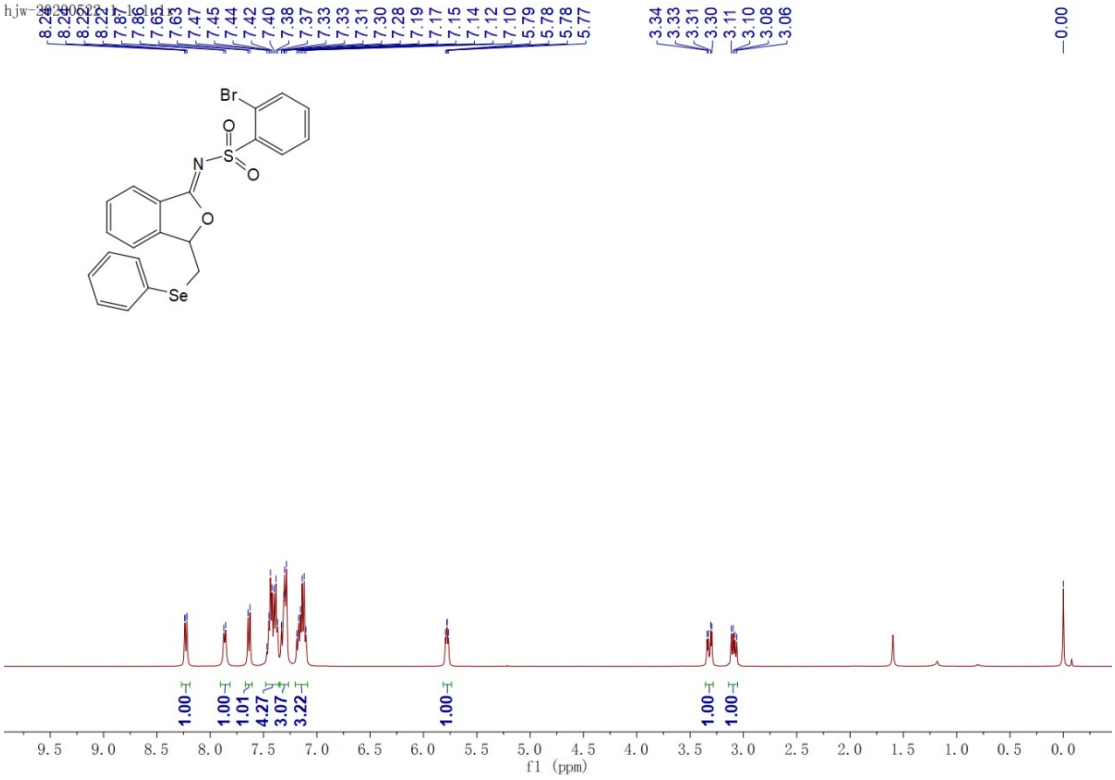

hjw-20200515-1.2.1.1r
167.44
146.71
139.41
134.44
133.81
133.52
132.75
131.60
130.54
129.96
129.31
129.13
128.50
127.94
126.72
125.55
122.27
86.39
77.44
77.13
76.81
31.11
Cl
O
N
S
O
O
Se
f1 (ppm)

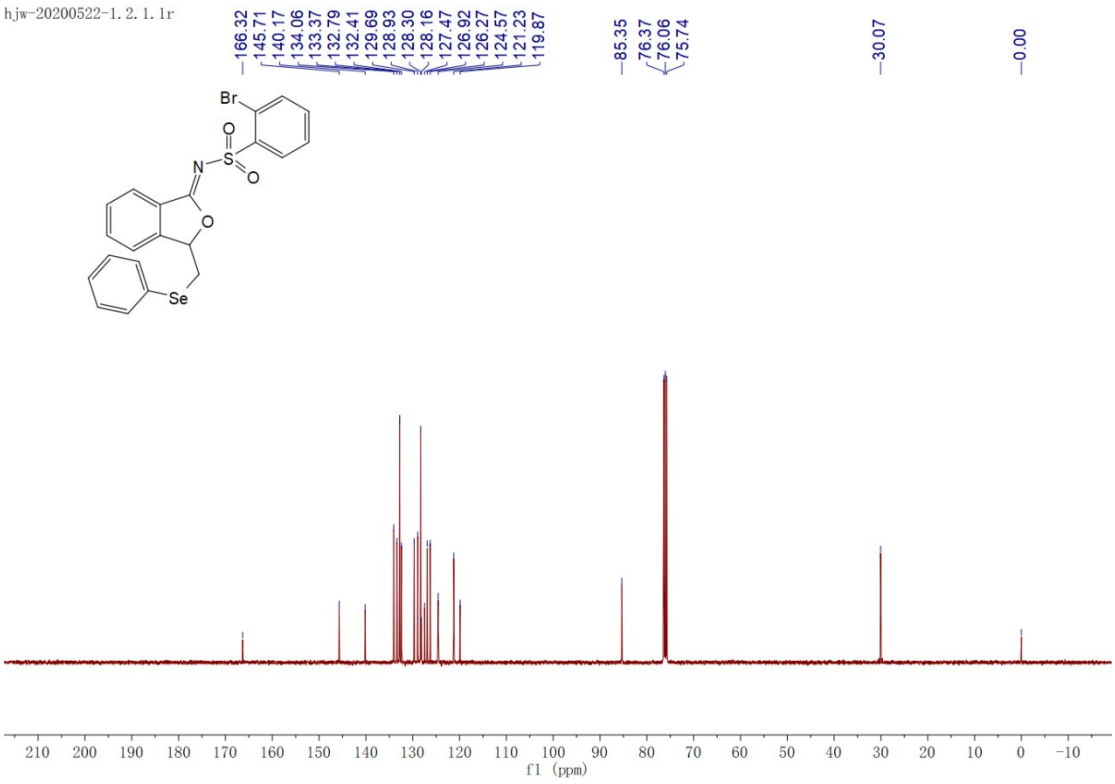
Product **3h**


Cl
O
N
S
O
O
Se
1.98
0.94
4.21
1.10
1.99
3.37
1.00
1.01
1.01
f1 (ppm)

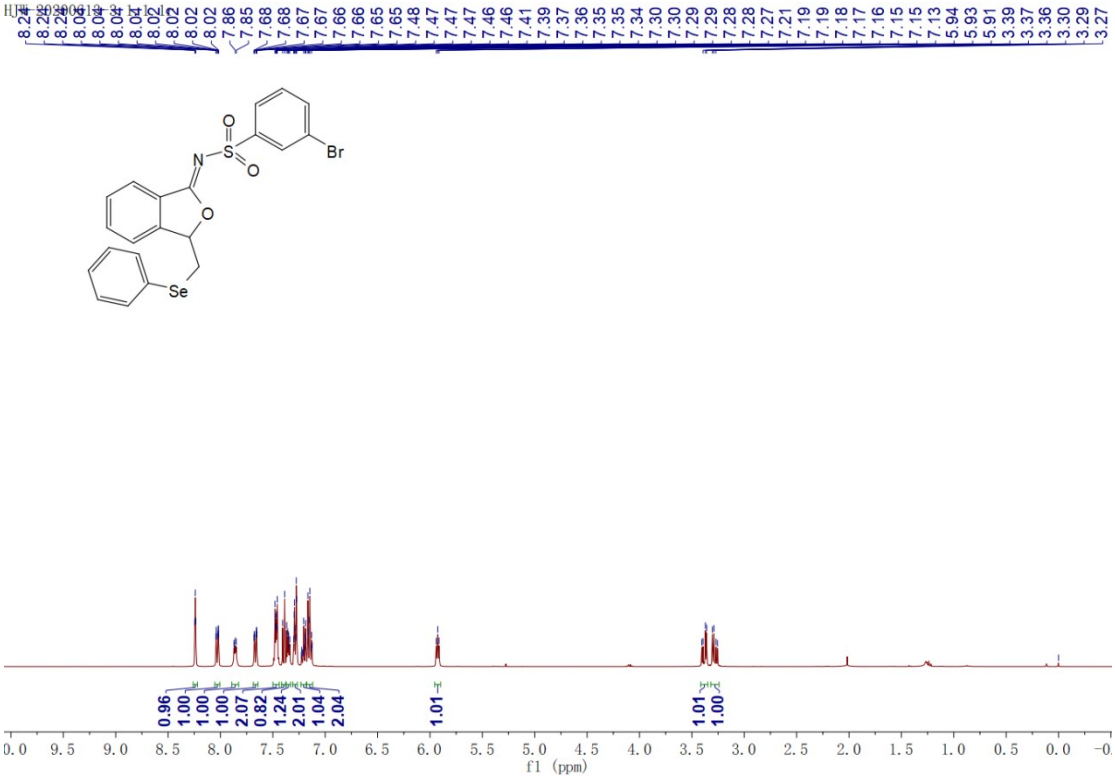

hjw-20200430-2.2.1.1r
166.44
145.63
138.81
138.12
133.43
132.87
128.93
128.35
128.28
128.12
127.86
127.40
127.03
124.54
121.15
85.39
76.34
76.02
75.71
30.21
0.00
Cl
O
N
S
O
O
Se
f1 (ppm)

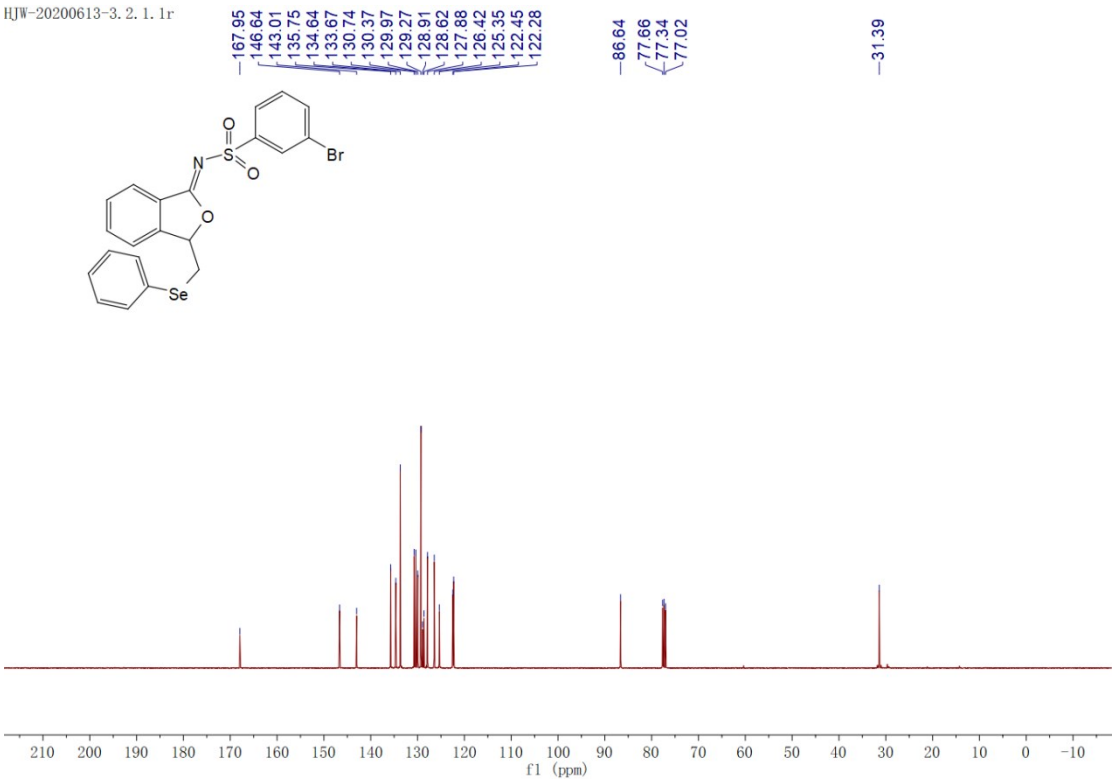
Product **3i**


8.24
8.22
7.87
7.86
7.65
7.63
7.47
7.45
7.44
7.42
7.40
7.38
7.37
7.33
7.33
7.31
7.30
7.28
7.19
7.17
7.15
7.14
7.12
7.10
5.79
5.78
5.78
5.77
3.34
3.33
3.31
3.30
3.11
3.10
3.08
3.06
0.00
Br
O
N
S
O
O
Se
1.00
1.00
1.01
4.27
3.07
3.22
1.00
1.00
1.00
f1 (ppm)

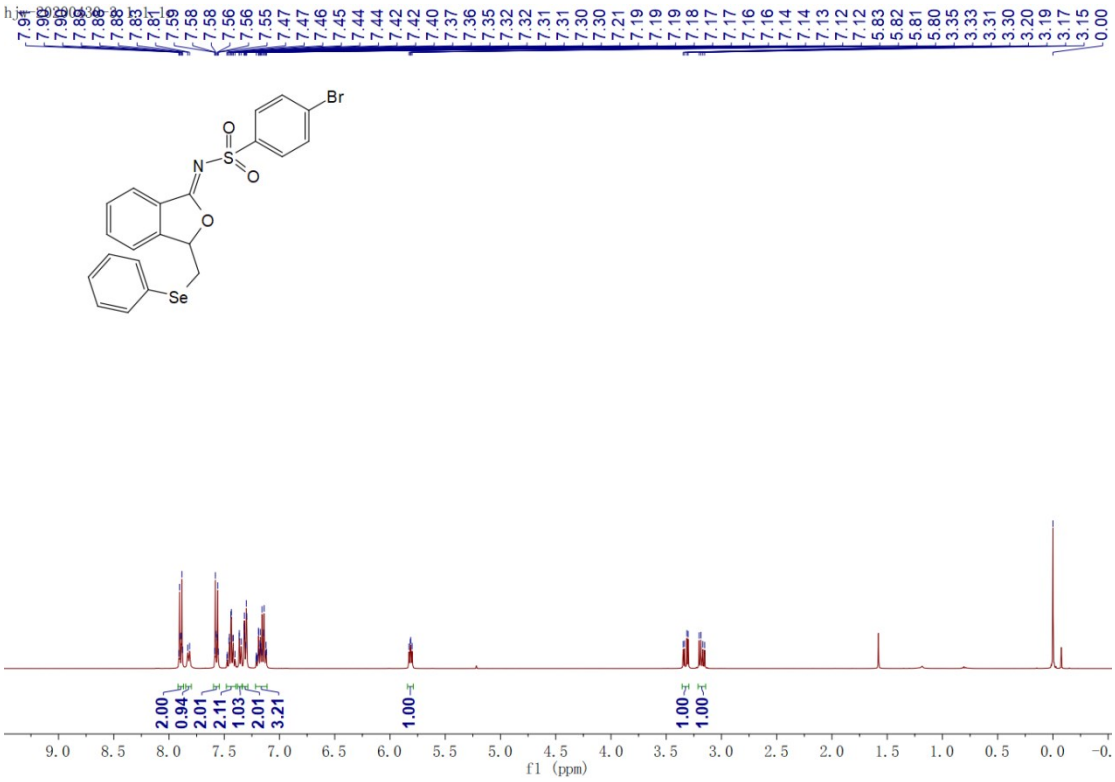

hjw-20200522-1.2.1.1r
166.32
145.71
140.17
134.06
133.37
132.79
132.41
129.69
128.93
128.30
128.16
127.47
126.92
126.27
124.57
121.23
119.87
85.35
76.37
76.06
75.74
30.07
0.00
Br
O
N
S
O
O
Se
f1 (ppm)

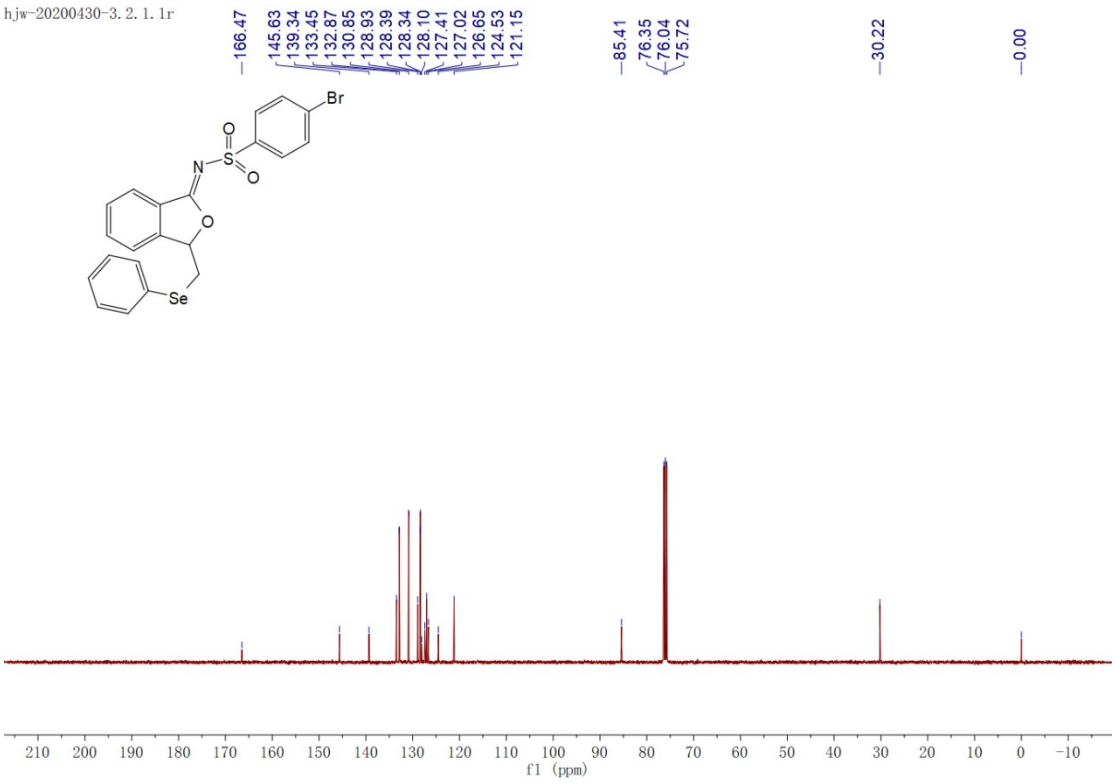
Product **3j**


8.24 8.24 8.23 8.04 8.04 8.04 8.04 8.02 8.02 8.02 8.02 7.86 7.85 7.68 7.68 7.67 7.67 7.66 7.66 7.65 7.65 7.48 7.47 7.47 7.47 7.46 7.46 7.41 7.39 7.37 7.36 7.35 7.35 7.34 7.30 7.30 7.29 7.29 7.28 7.28 7.27 7.21 7.19 7.19 7.18 7.17 7.16 7.15 7.13 5.94 5.93 5.91 3.39 3.37 3.36 3.30 3.29 3.27
O
S
N
O
Br
O
Se
0.96 1.00 1.00 1.00 2.07 0.82 1.24 2.01 1.04 2.04 1.01 1.01 1.00
f1 (ppm)

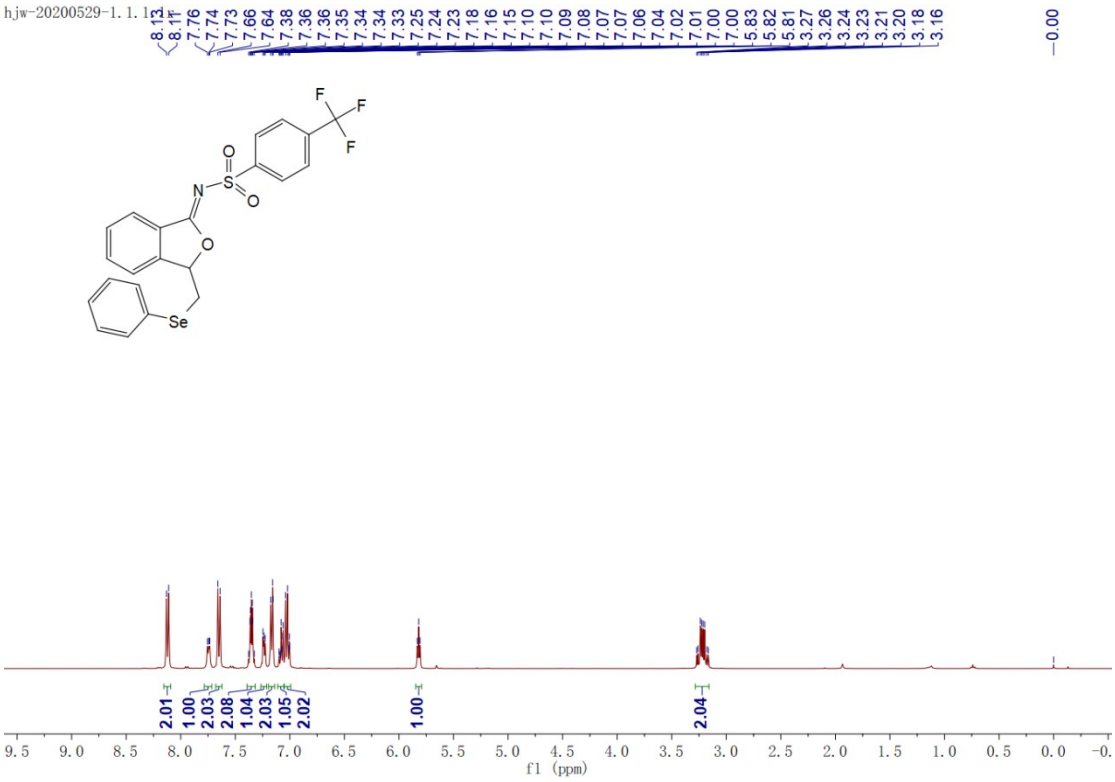

HJW-20200613-3.2.1.1r
167.95 146.64 143.01 135.75 134.64 133.67 130.74 130.37 129.97 129.27 128.91 128.62 127.88 126.42 125.35 122.45 122.28
86.64 77.66 77.34 77.02 31.39
O
S
N
O
Br
O
Se
f1 (ppm)

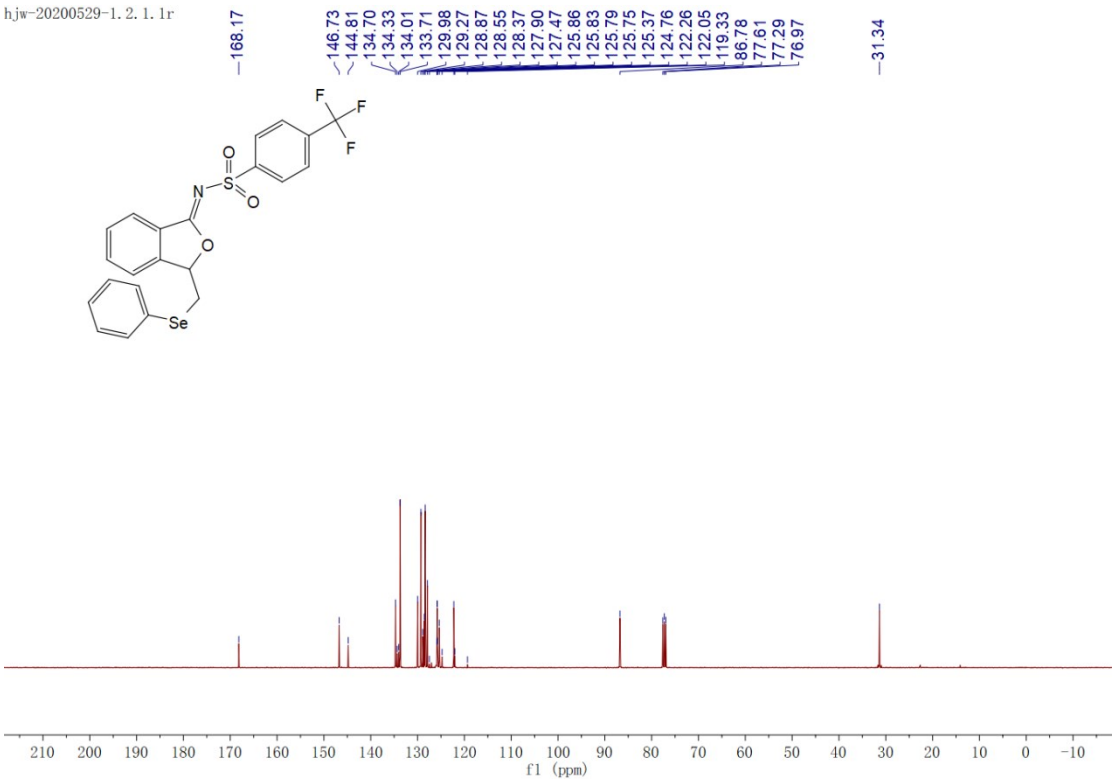
Product **3k**


Br
O
N
S
O
O
Se
2.00
0.94
2.01
2.11
1.03
2.01
3.21
1.00
1.00
1.00
f1 (ppm)

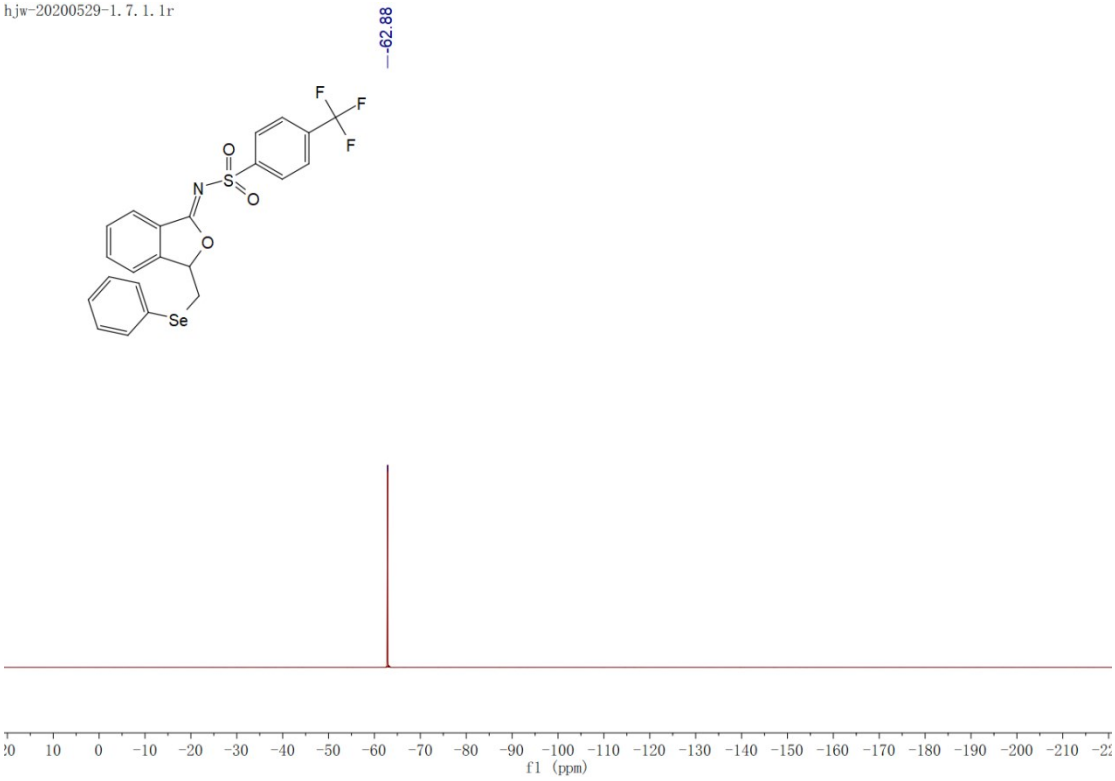

hjw-20200430-3.2.1.1r
166.47
145.63
139.34
133.45
132.87
130.85
128.93
128.39
128.34
128.10
127.41
127.02
126.65
124.53
121.15
85.41
76.35
76.04
75.72
30.22
0.00
Br
O
N
S
O
O
Se
f1 (ppm)

Product **3l**

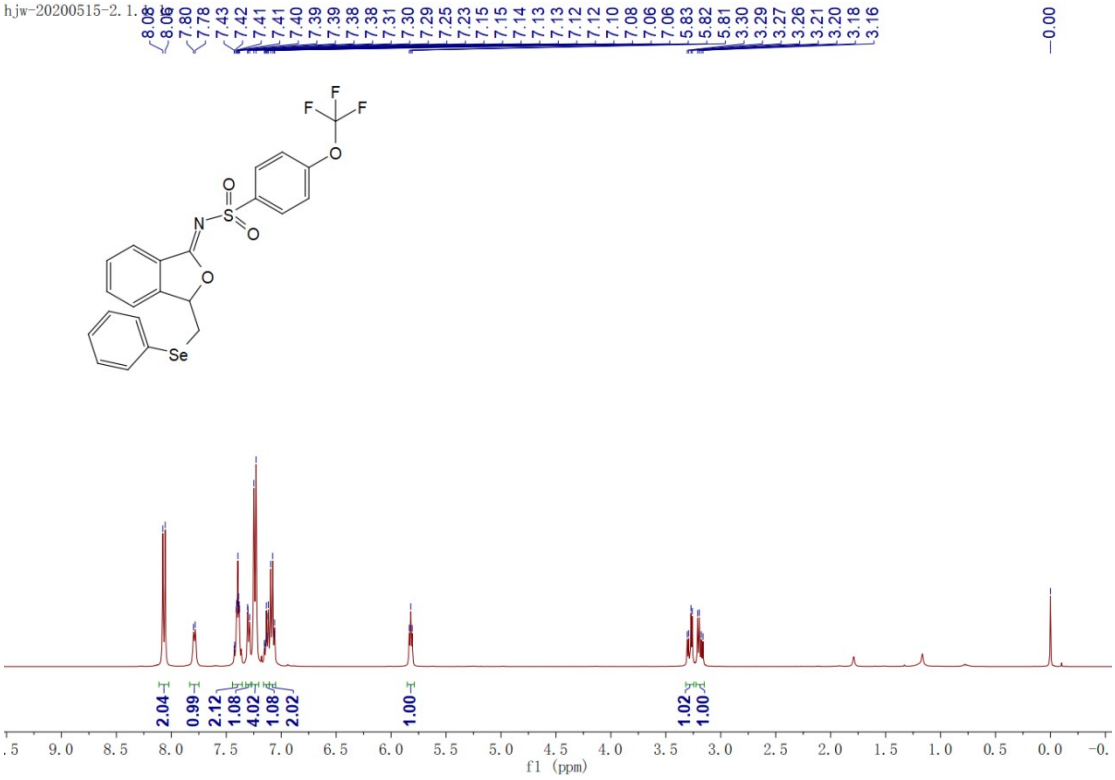

hjw-20200529-1.1.1r
8.12
8.11
7.76
7.74
7.73
7.66
7.64
7.38
7.36
7.36
7.35
7.34
7.34
7.33
7.25
7.24
7.23
7.18
7.16
7.15
7.10
7.10
7.09
7.08
7.07
7.07
7.06
7.04
7.02
7.01
7.00
7.00
5.83
5.82
5.81
3.27
3.26
3.24
3.23
3.21
3.20
3.18
3.16
0.00
F
F
F
O
N
S
O
O
Se
2.01
1.00
2.03
2.08
1.04
2.03
1.05
2.02
1.00
2.04
f1 (ppm)

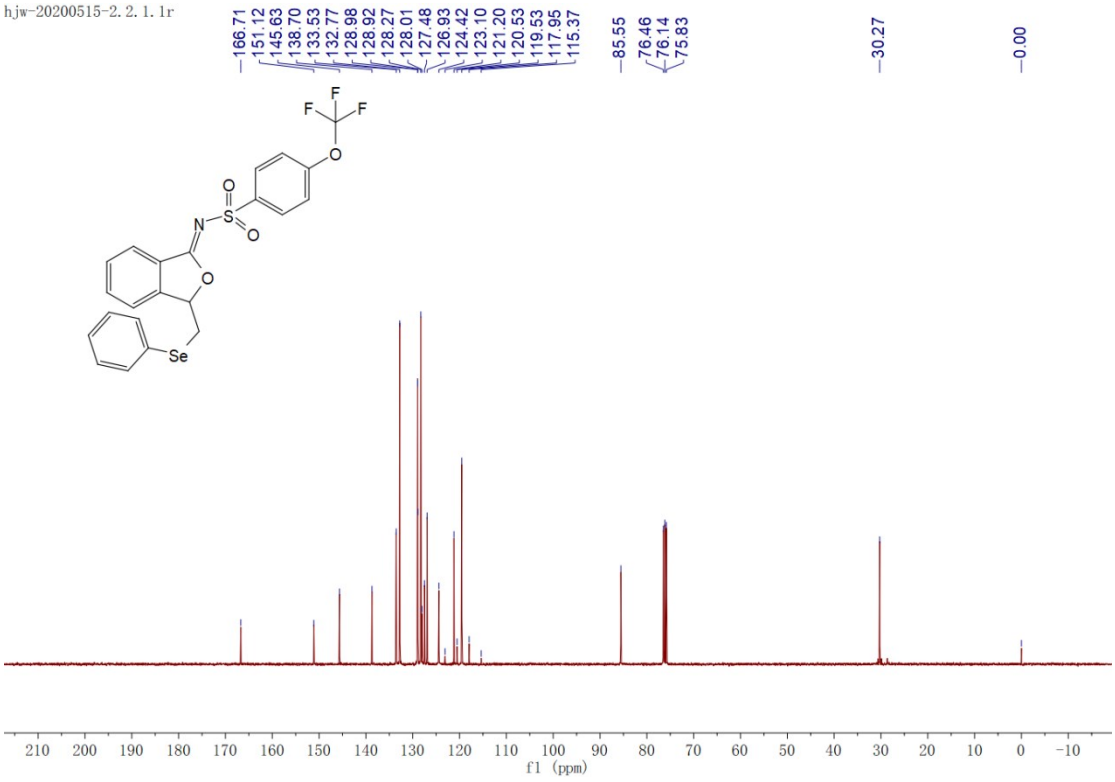

hjw-20200529-1.2.1.1r
168.17
146.73
144.81
134.70
134.33
134.01
133.71
129.98
129.27
128.87
128.55
128.37
127.90
127.47
125.86
125.83
125.79
125.75
125.37
124.76
122.26
122.05
119.33
86.78
77.61
77.29
76.97
31.34
F
F
F
O
N
S
O
O
Se
f1 (ppm)

hjw-20200529-1.7.1.1r

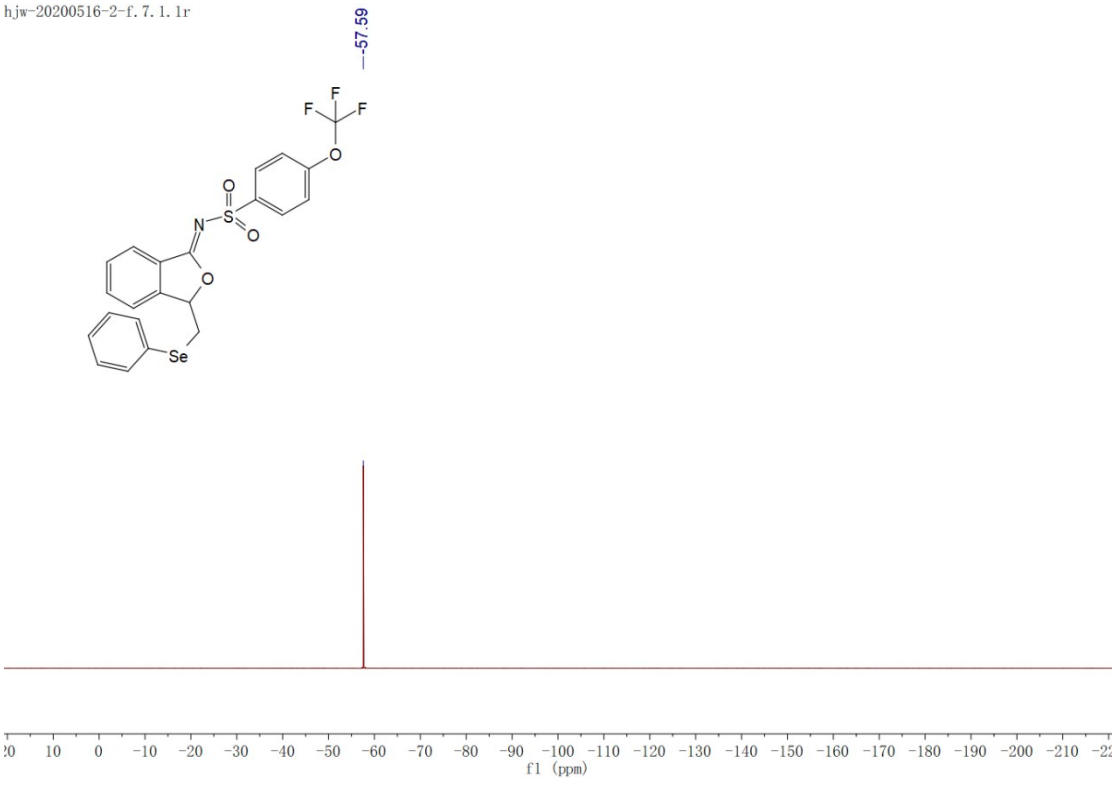


Product **3m**

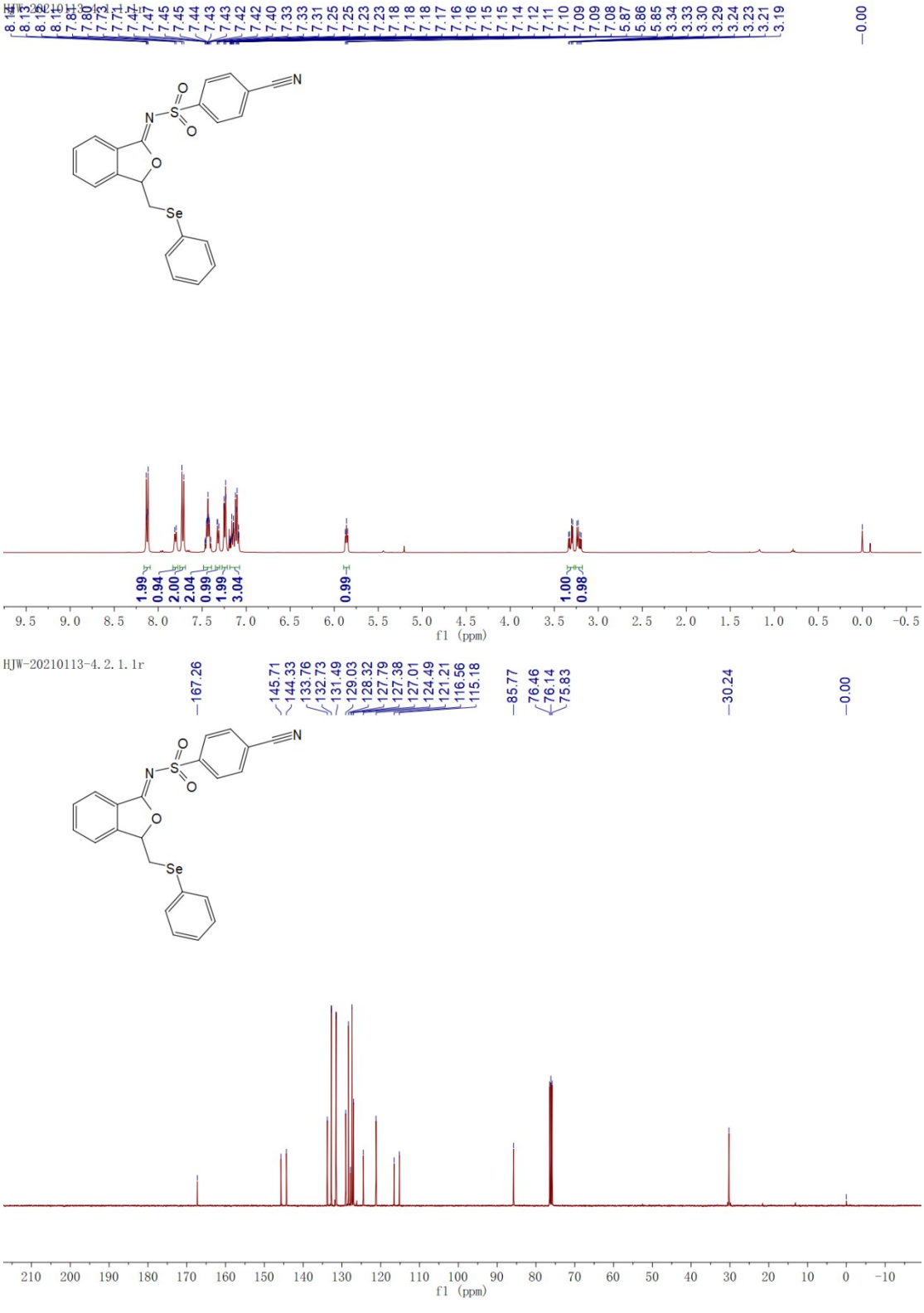

hjw-20200515-2.1.8
8.08
8.06
7.80
7.78
7.43
7.42
7.41
7.41
7.41
7.40
7.39
7.39
7.39
7.38
7.38
7.31
7.30
7.29
7.25
7.23
7.15
7.15
7.14
7.13
7.13
7.12
7.12
7.10
7.08
7.06
7.06
5.83
5.82
5.81
3.30
3.29
3.27
3.26
3.21
3.20
3.18
3.16
0.00
F
F
F
O
O
N
S
O
O
Se
2.04
0.99
2.12
1.08
4.02
1.08
2.02
1.00
1.02
1.00
f1 (ppm)


hjw-20200515-2.2.1.1r
166.71
151.12
145.63
138.70
133.53
132.77
128.98
128.92
128.27
128.01
127.48
126.93
124.42
123.10
121.20
120.53
119.53
117.95
115.37
85.55
76.46
76.14
75.83
30.27
0.00
F
F
F
O
O
N
S
O
O
Se
f1 (ppm)

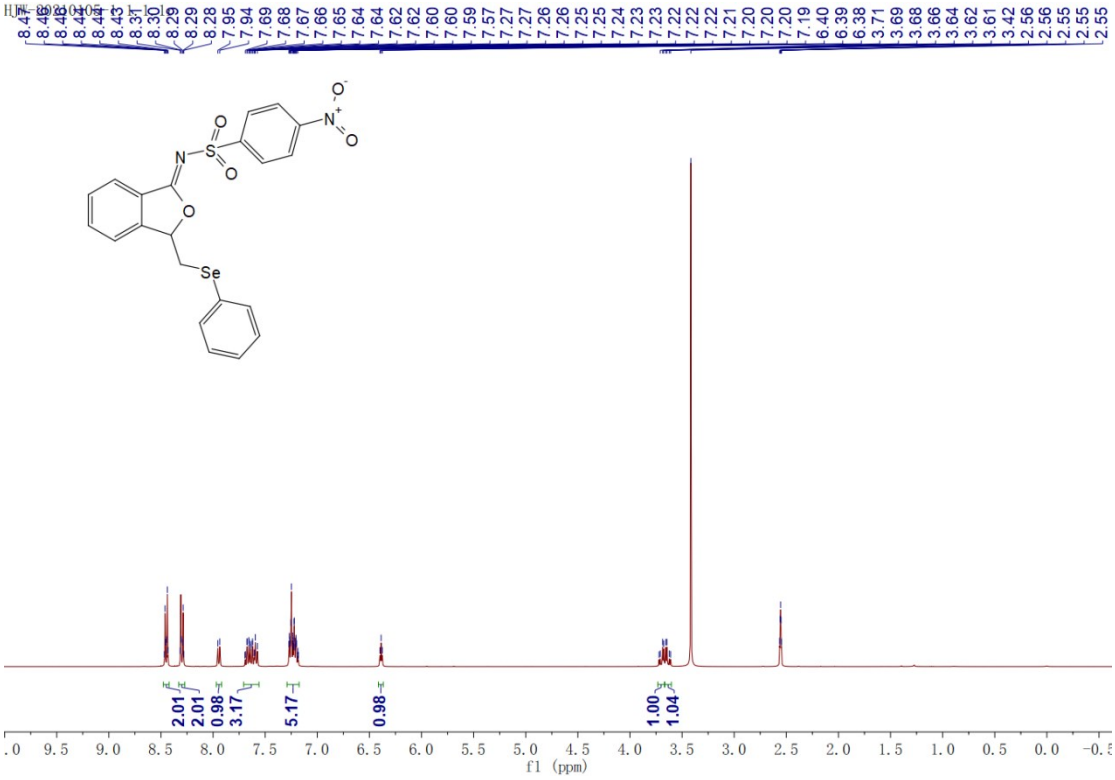
hjw-20200516-2-f.7.1.1r

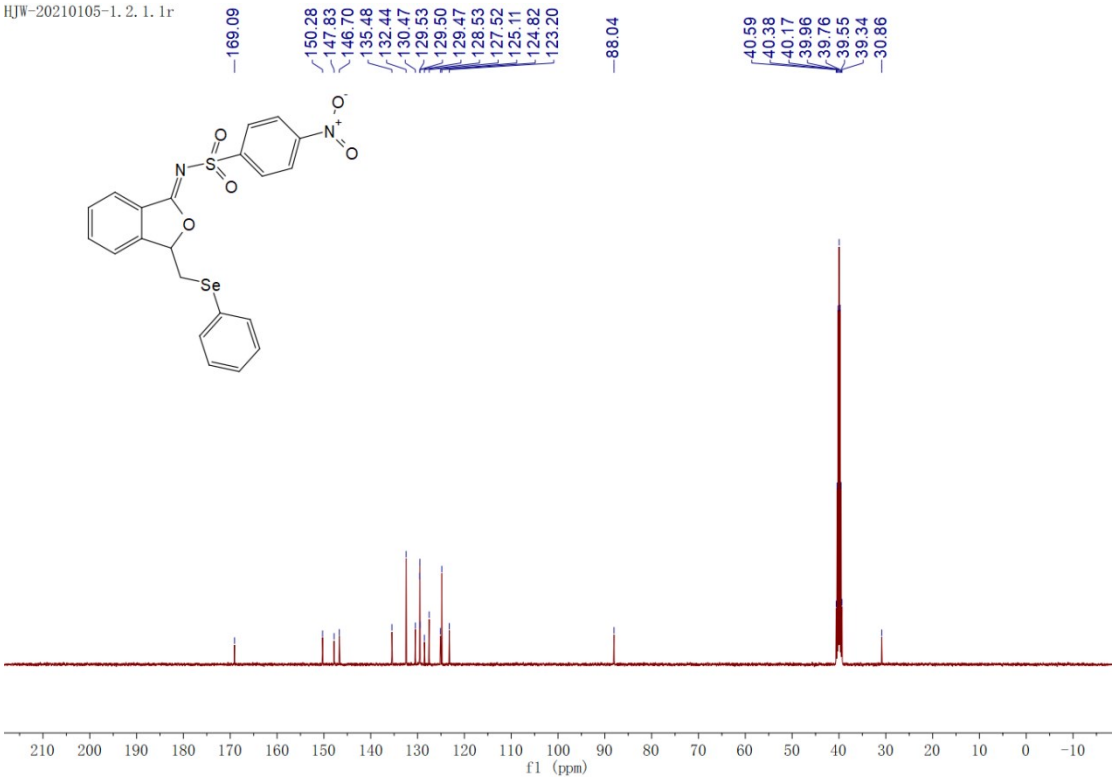


Product **3n**

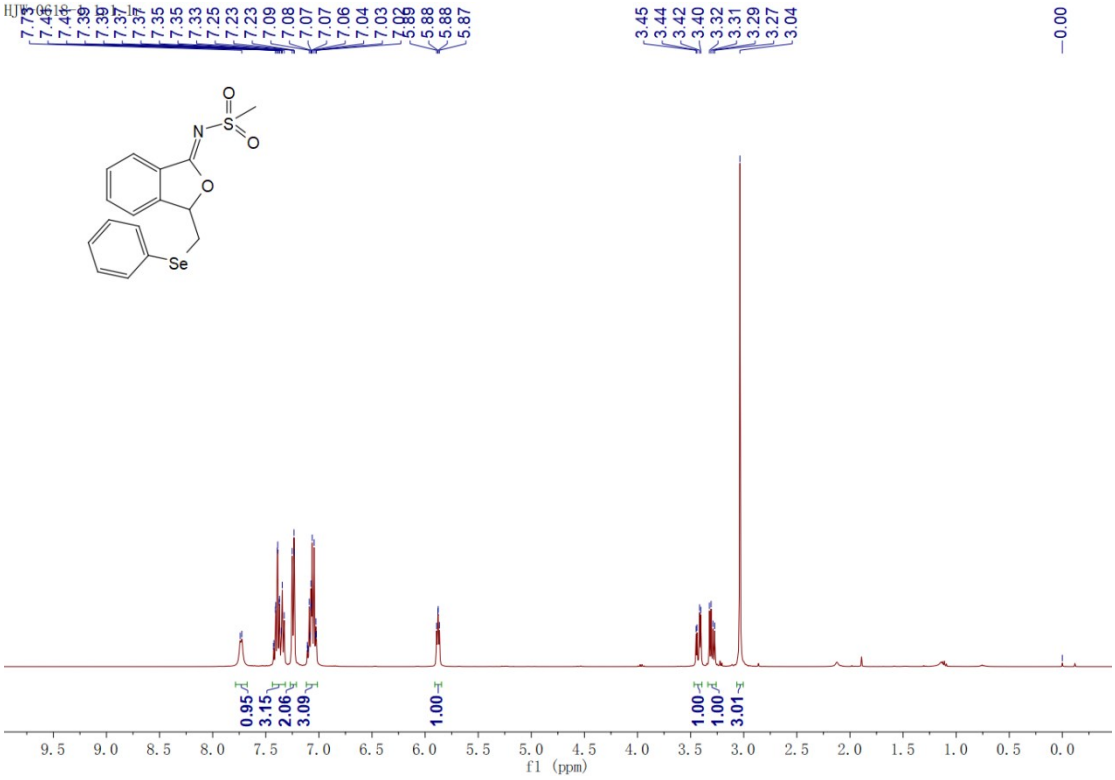

HJW-20210113
8.14
8.13
8.12
8.11
8.10
7.80
7.79
7.78
7.77
7.47
7.47
7.45
7.45
7.44
7.43
7.43
7.42
7.42
7.40
7.33
7.33
7.31
7.25
7.25
7.23
7.18
7.18
7.17
7.16
7.16
7.15
7.15
7.14
7.12
7.11
7.10
7.09
7.09
7.08
5.87
5.86
5.85
3.34
3.33
3.30
3.29
3.24
3.23
3.21
3.19
0.00
O
N
S
O
N
O
Se
1.99
0.94
2.00
2.04
0.99
1.99
3.04
0.99
1.00
0.98
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)
HJW-20210113-4.2.1.1r
167.26
145.71
144.33
133.76
132.73
131.49
129.03
128.32
127.79
127.38
127.01
124.49
121.21
116.56
115.18
85.77
76.46
76.14
75.83
30.24
0.00
O
N
S
O
N
O
Se
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

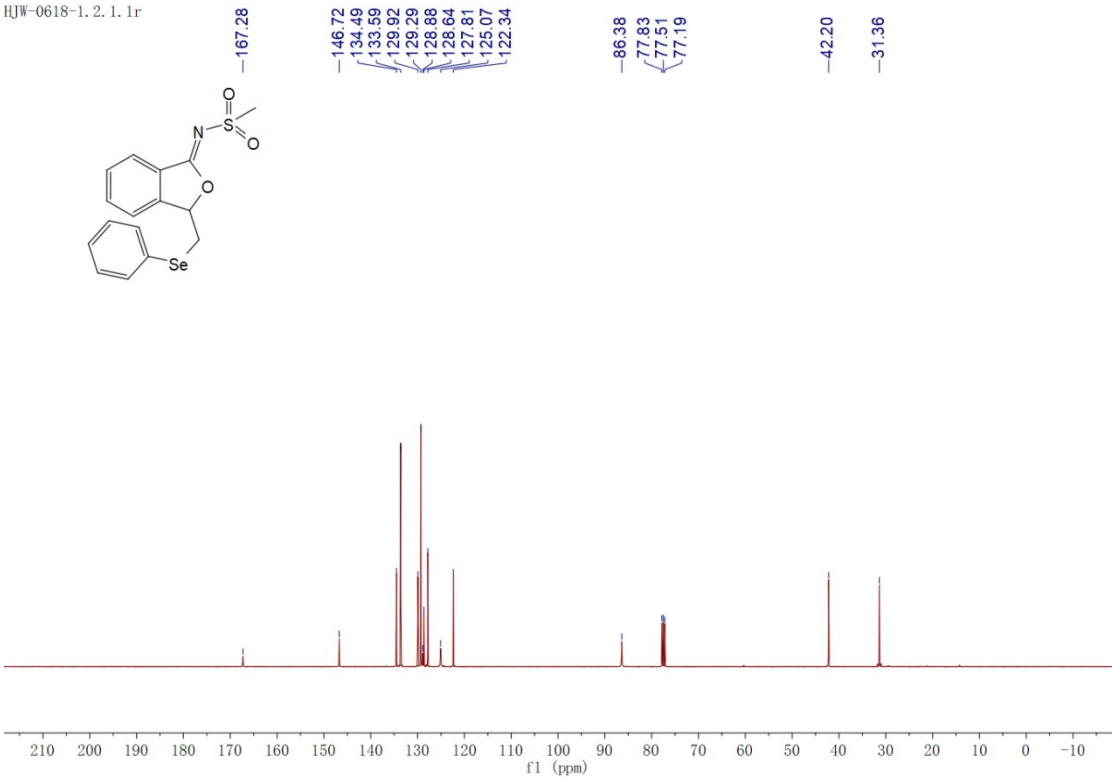
Product **3o**


8.47 8.46 8.46 8.45 8.44 8.43 8.31 8.30 8.29 8.29 8.28 7.95 7.94 7.69 7.68 7.67 7.66 7.65 7.64 7.64 7.62 7.62 7.60 7.60 7.59 7.57 7.27 7.27 7.26 7.26 7.25 7.25 7.24 7.23 7.23 7.22 7.22 7.22 7.21 7.20 7.20 7.20 7.19 6.40 6.39 6.38 3.71 3.69 3.68 3.66 3.64 3.62 3.61 3.42 2.56 2.56 2.55 2.55 2.55
O
N+
O-
O
N
S
O
O
Se
2.01 2.01 0.98 3.17 5.17 0.98 1.00 1.04
f1 (ppm)

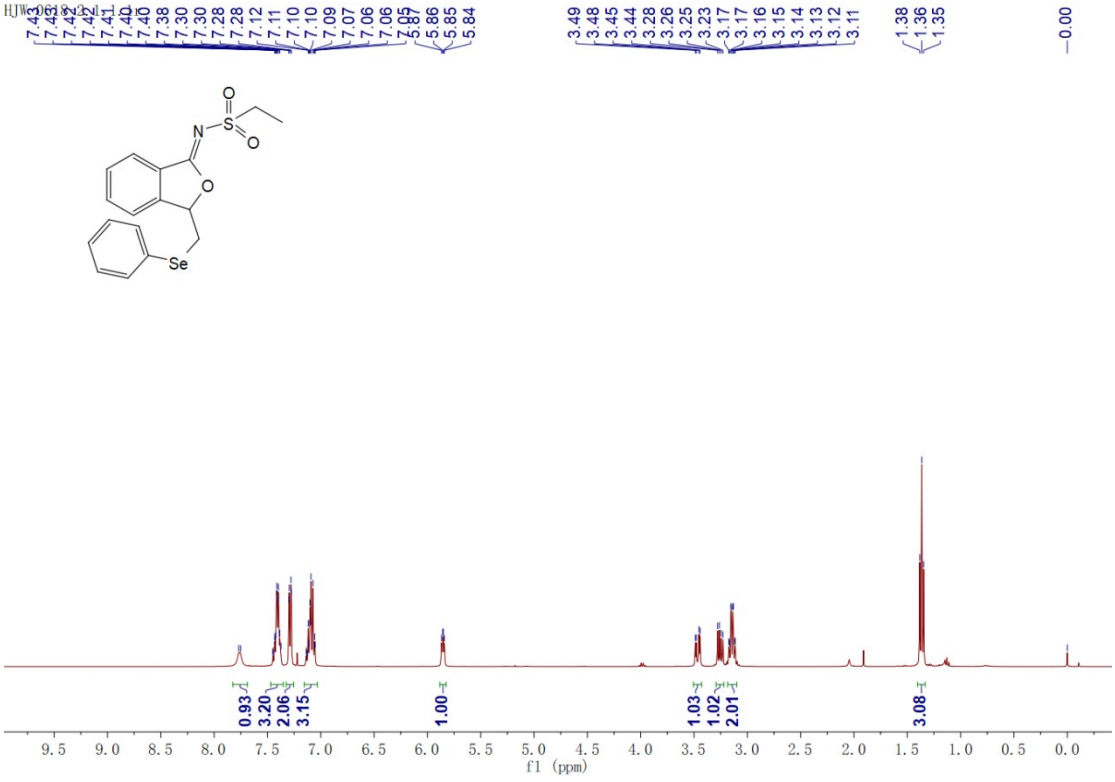

HJW-20210105-1.2.1.1r
169.09 150.28 147.83 146.70 135.48 132.44 130.47 129.53 129.50 129.47 128.53 127.52 125.11 124.82 123.20 88.04 40.59 40.38 40.17 39.96 39.76 39.55 39.34 30.86
O
N+
O-
O
N
S
O
O
Se
f1 (ppm)

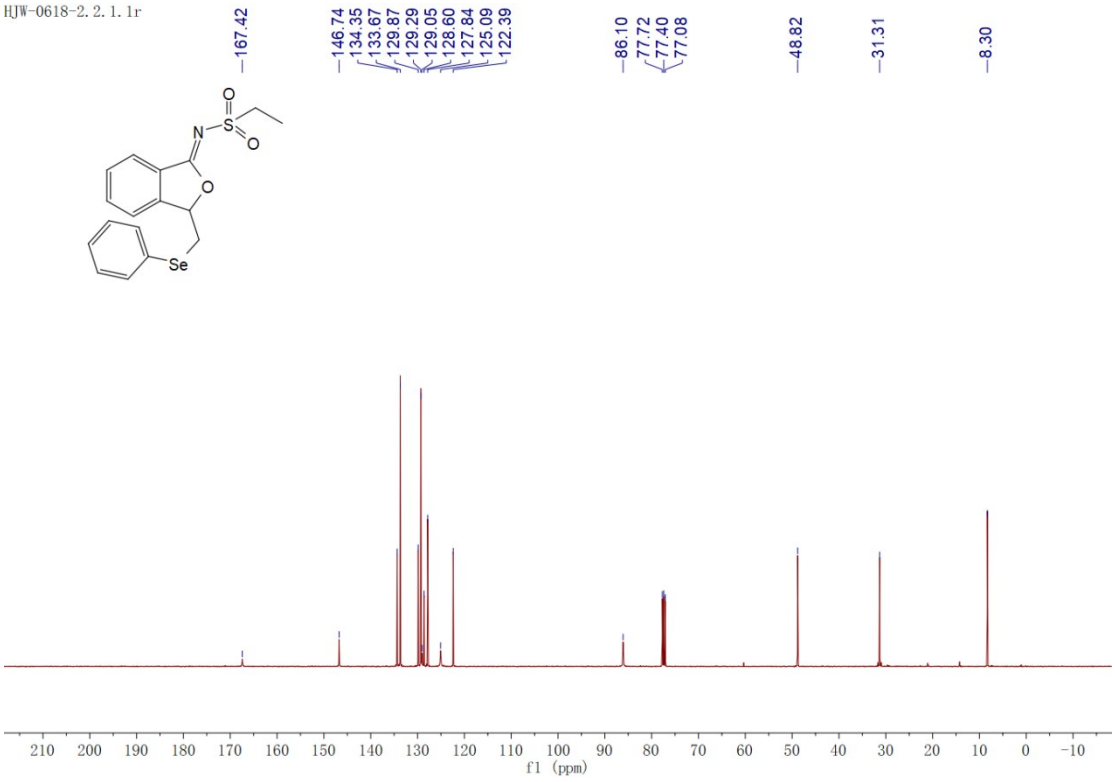
Product 3p


7.75
7.45
7.44
7.39
7.38
7.37
7.37
7.35
7.35
7.33
7.25
7.23
7.23
7.09
7.08
7.07
7.07
7.06
7.04
7.03
5.89
5.88
5.88
5.87
3.45
3.44
3.42
3.40
3.32
3.31
3.29
3.27
3.04
0.00
0.95
3.15
2.06
3.09
1.00
1.00
1.00
3.01
f1 (ppm)

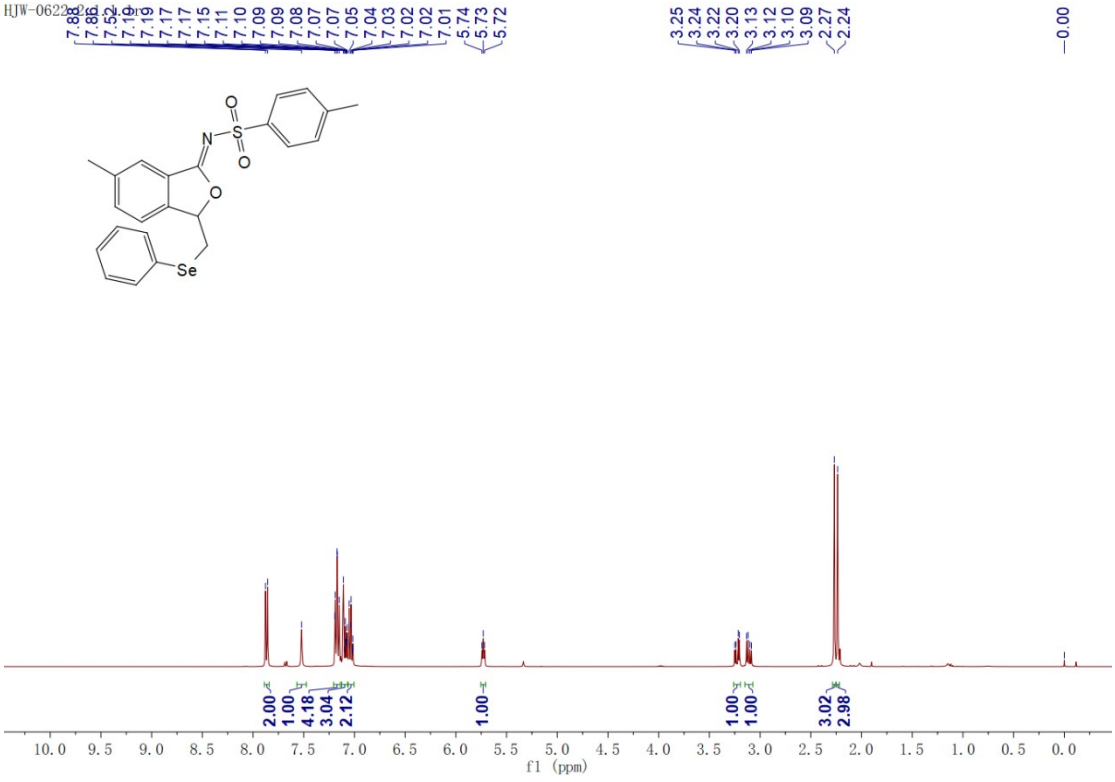

HJW-0618-1.2.1.1r
167.28
146.72
134.49
133.59
129.92
129.29
128.88
128.64
127.81
125.07
122.34
86.38
77.83
77.51
77.19
42.20
31.36
f1 (ppm)

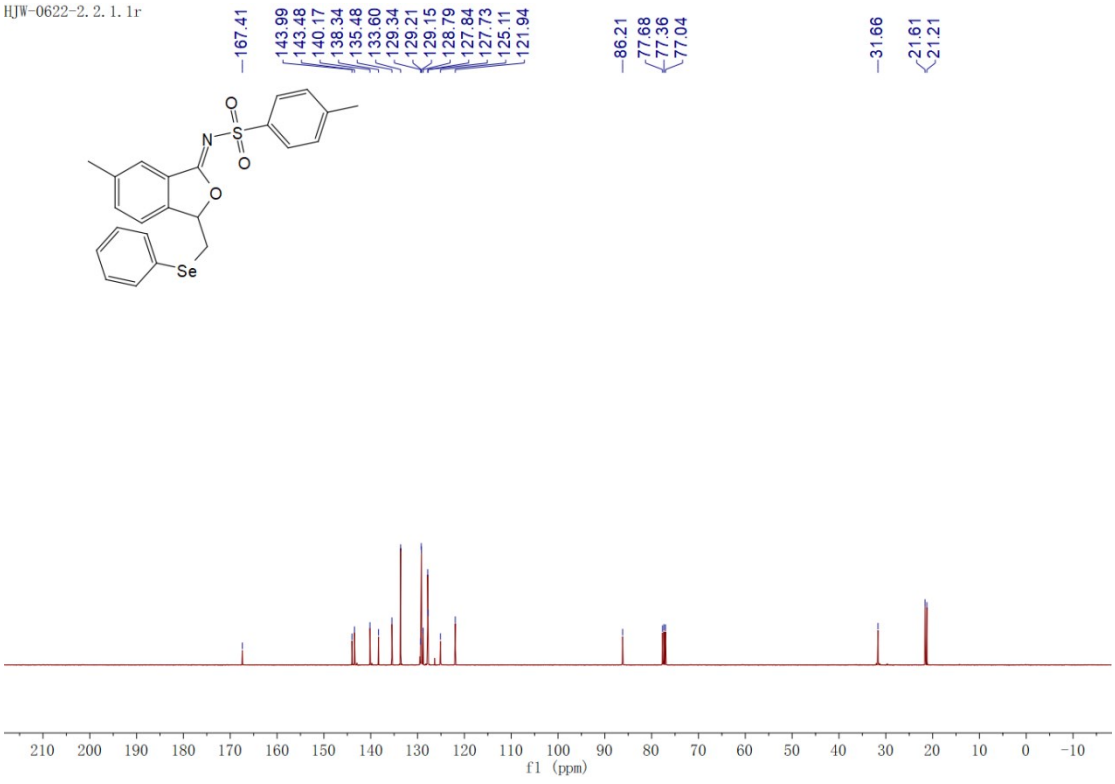
Product **3q**


7.43
7.43
7.42
7.42
7.41
7.40
7.40
7.38
7.30
7.30
7.28
7.28
7.12
7.11
7.10
7.10
7.09
7.07
7.06
7.06
7.05
5.87
5.86
5.85
5.84
3.49
3.48
3.45
3.44
3.28
3.26
3.25
3.23
3.17
3.17
3.16
3.15
3.14
3.13
3.12
3.11
1.38
1.36
1.35
0.00
O
N
S
O
O
Se
0.93
3.20
2.06
3.15
1.00
1.03
1.02
2.01
3.08
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

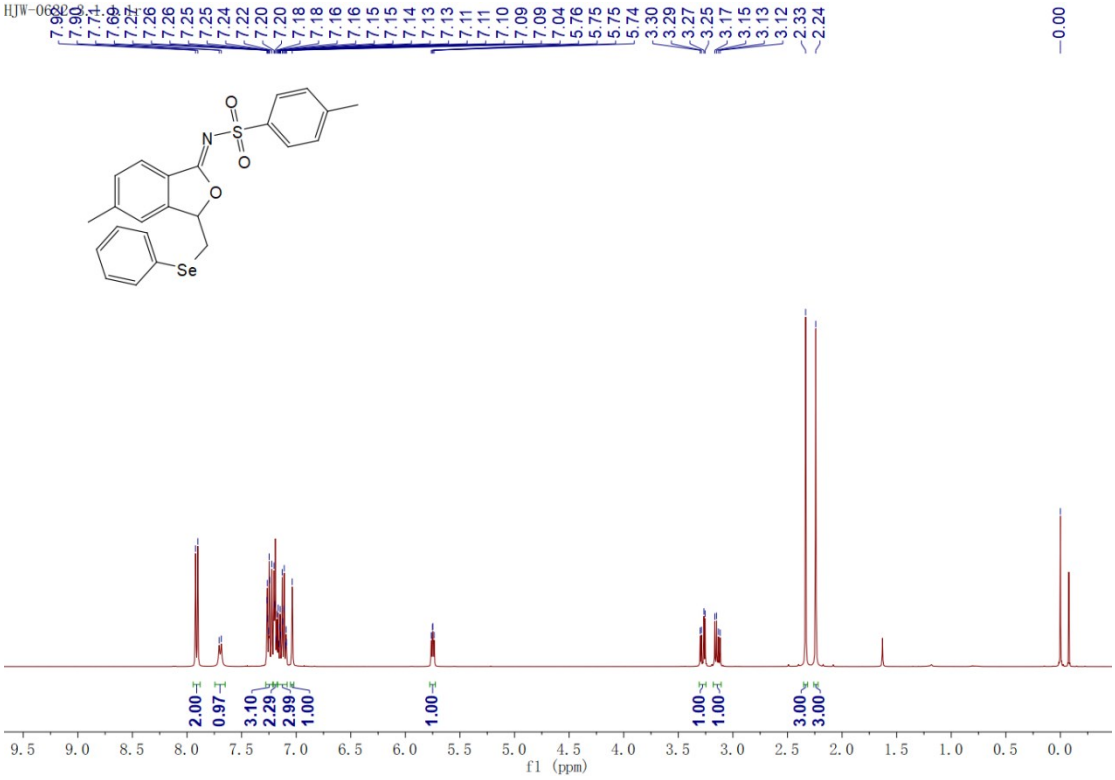

HJW-0618-2.2.1.1r
167.42
146.74
134.35
133.67
129.87
129.29
129.05
128.60
127.84
125.09
122.39
86.10
77.72
77.40
77.08
48.82
31.31
8.30
O
N
S
O
O
Se
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

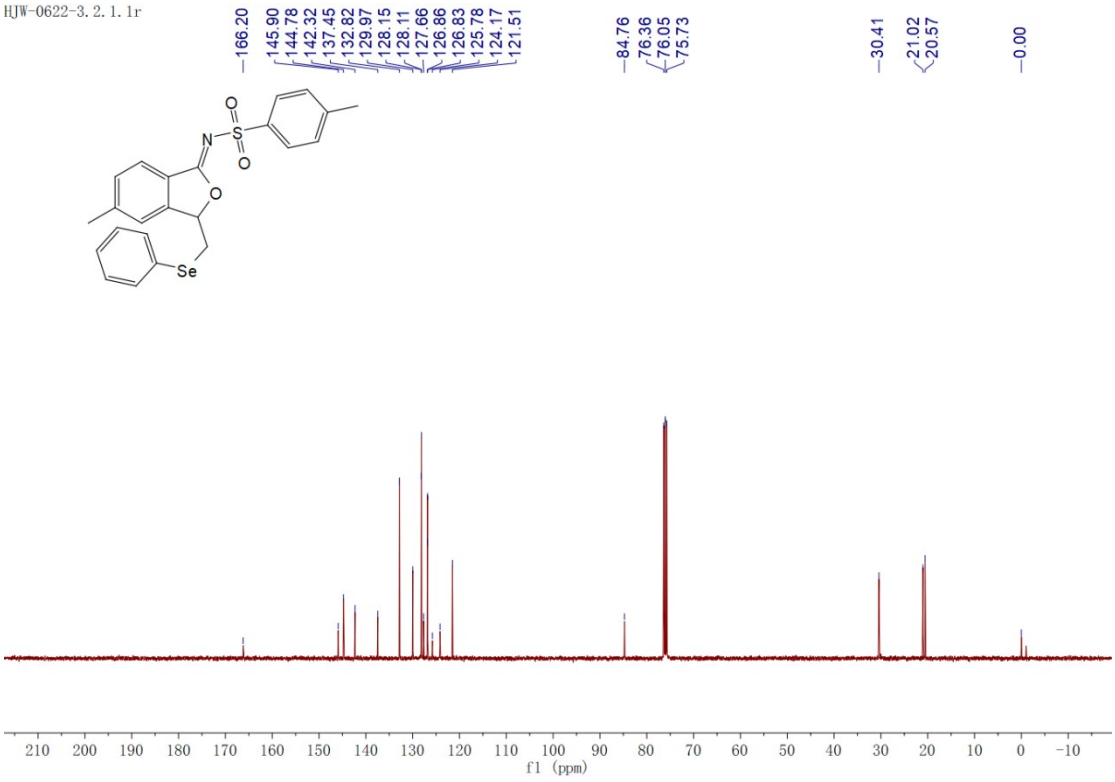
Product **3r**


HJW-0622-2
7.88
7.86
7.52
7.19
7.19
7.17
7.17
7.15
7.11
7.10
7.09
7.09
7.08
7.07
7.07
7.05
7.04
7.03
7.02
7.02
7.01
5.74
5.73
5.72
3.25
3.24
3.22
3.20
3.13
3.12
3.10
3.09
2.27
2.24
0.00
O
N
S
O
O
Se
2.00
1.00
4.18
3.04
2.12
1.00
1.00
1.00
3.02
2.98
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

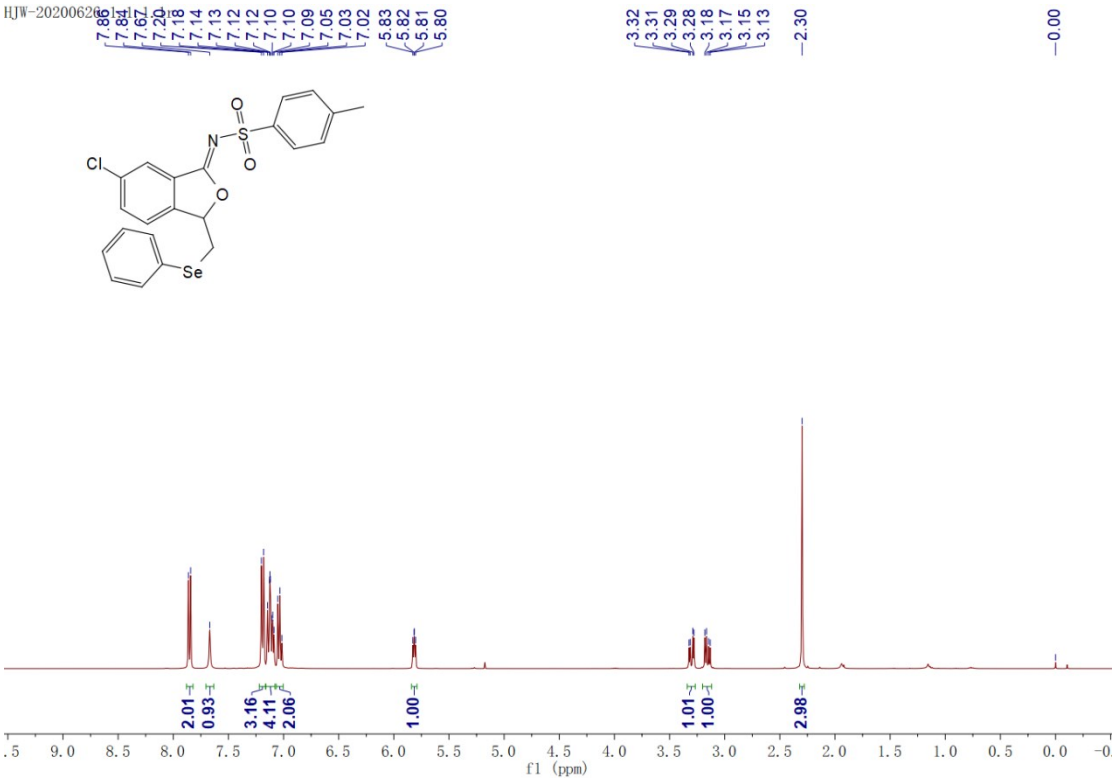

HJW-0622-2.2.1.1r
167.41
143.99
143.48
140.17
138.34
135.48
133.60
129.34
129.21
129.15
128.79
127.84
127.73
125.11
121.94
86.21
77.68
77.36
77.04
31.66
21.61
21.21
O
N
S
O
O
Se
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

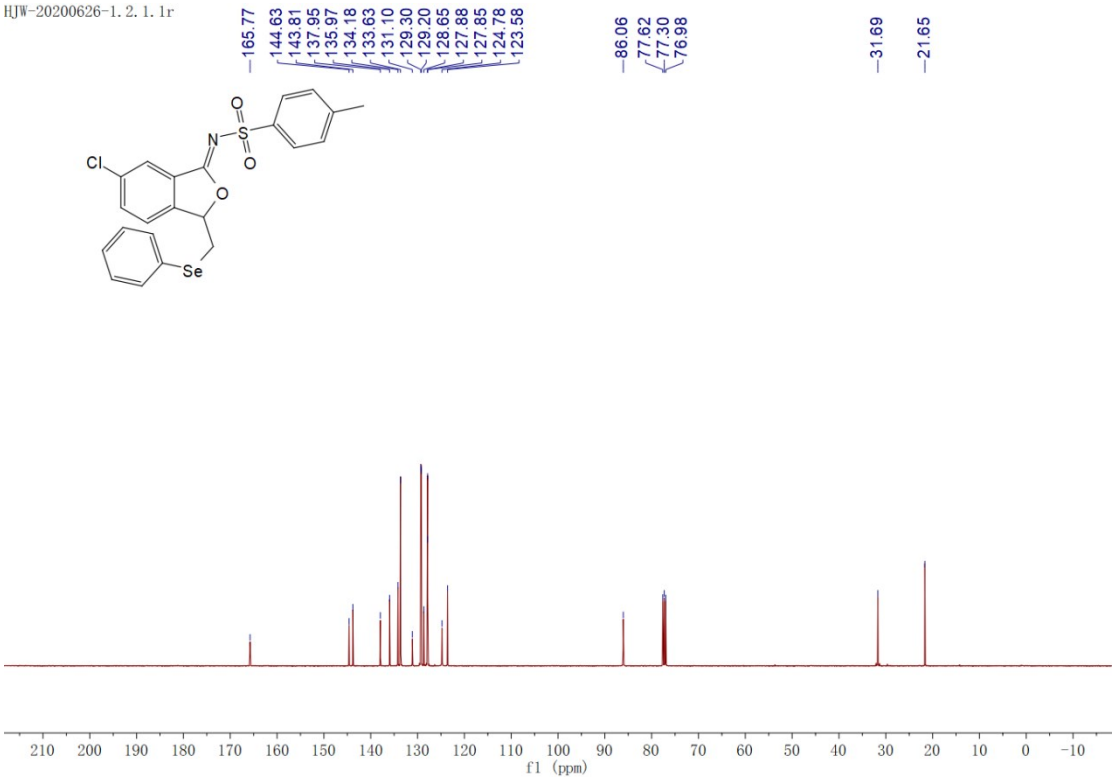
Product **3s**


HJW-0622
7.90
7.74
7.69
7.26
7.25
7.24
7.22
7.20
7.18
7.16
7.15
7.14
7.13
7.11
7.10
7.09
7.04
5.76
5.75
5.74
3.30
3.29
3.27
3.25
3.17
3.15
3.13
3.12
2.33
2.24
0.00
O
N
S
O
O
Se
2.00
0.97
3.10
2.29
2.99
1.00
1.00
1.00
1.00
3.00
3.00
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

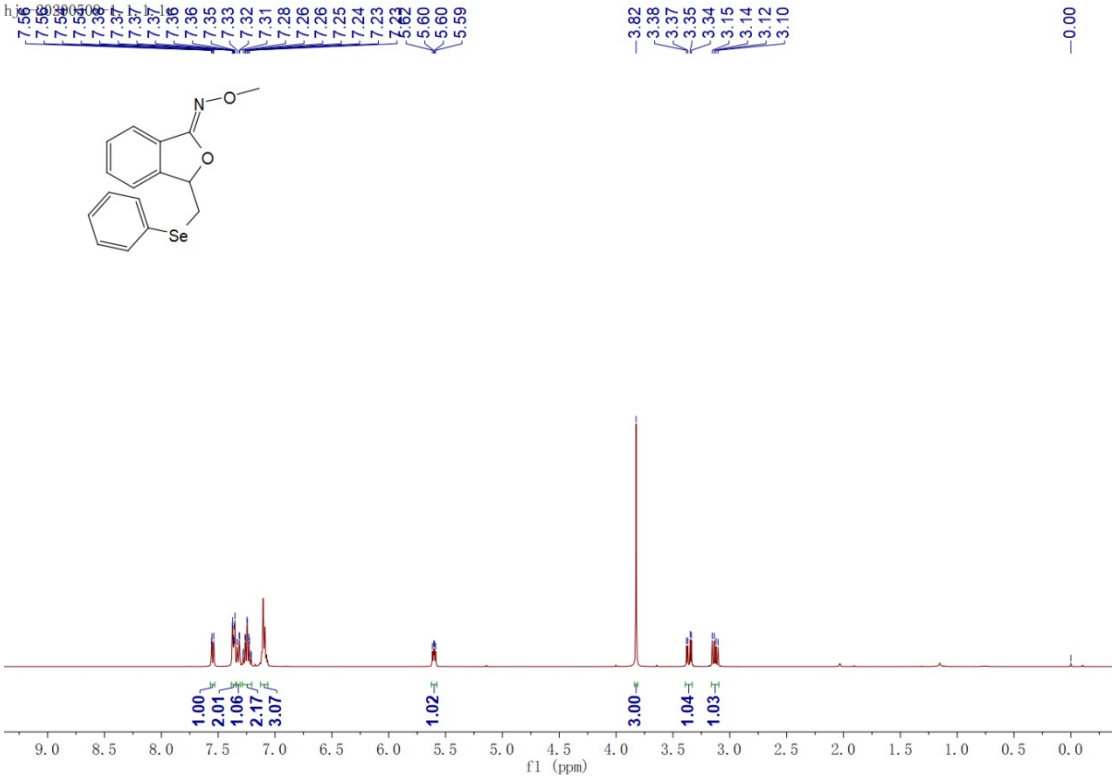

HJW-0622-3.2.1.1r
166.20
145.90
144.78
142.32
137.45
132.82
129.97
128.15
128.11
127.66
126.86
126.83
125.78
124.17
121.51
84.76
76.36
76.05
75.73
30.41
21.02
20.57
0.00
O
N
S
O
O
Se
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

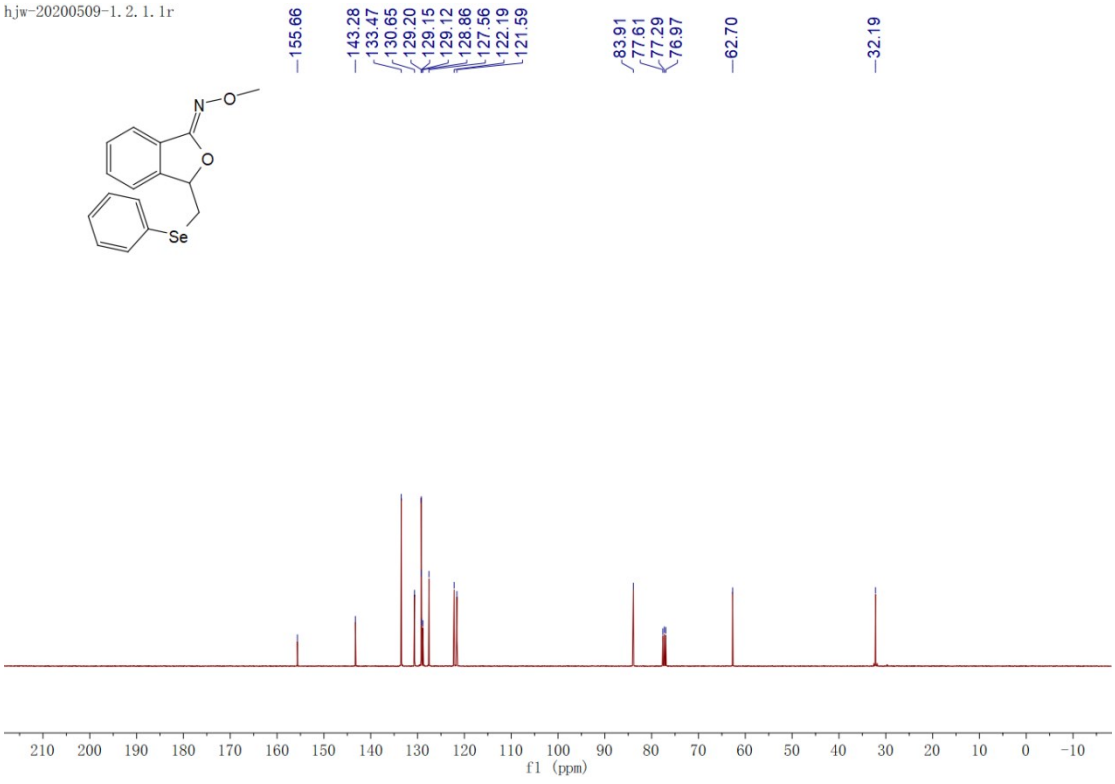
Product **3t**


HJW-20200626
7.86
7.84
7.67
7.20
7.18
7.14
7.13
7.12
7.12
7.10
7.10
7.09
7.05
7.03
7.02
5.83
5.82
5.81
5.80
3.32
3.31
3.29
3.28
3.18
3.17
3.15
3.13
2.30
0.00
Cl
N
S
O
O
O
Se
2.01
0.93
3.16
4.11
2.06
1.00
1.01
1.00
2.98
f1 (ppm)

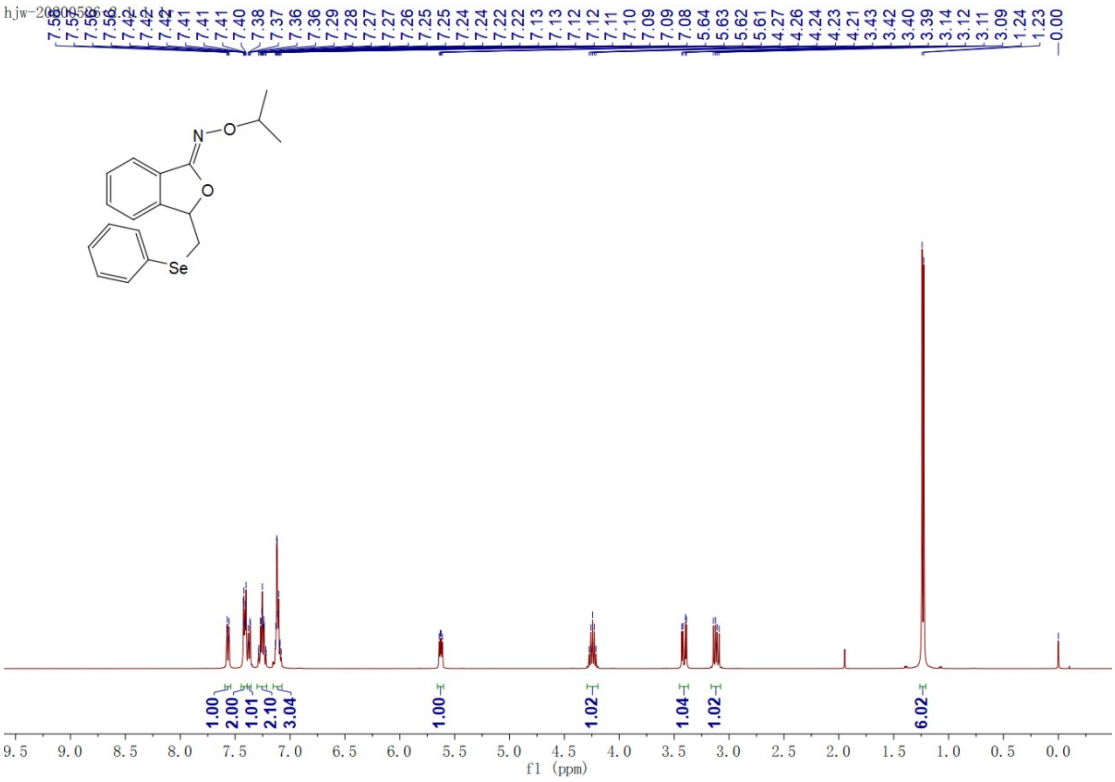

HJW-20200626-1.2.1.1r
165.77
144.63
143.81
137.95
135.97
134.18
133.63
131.10
129.30
129.20
128.65
127.88
127.85
124.78
123.58
86.06
77.62
77.30
76.98
31.69
21.65
Cl
N
S
O
O
O
Se
f1 (ppm)

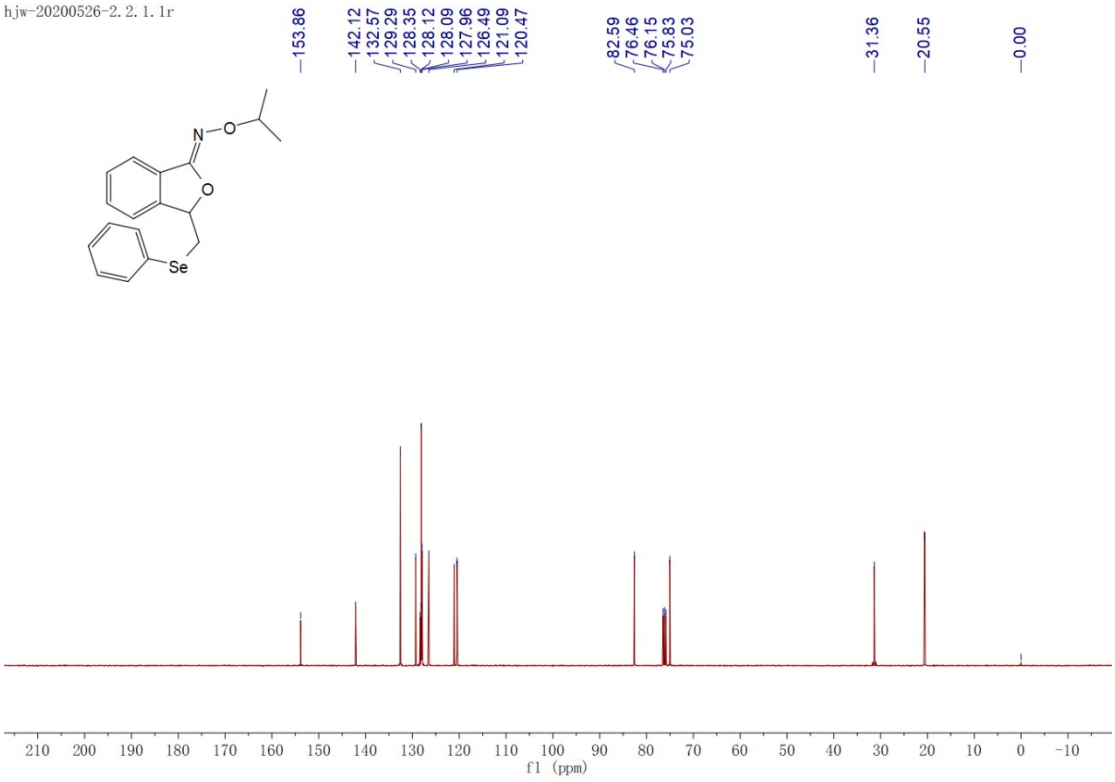
Product **3u**


7.56
7.56
7.54
7.54
7.38
7.37
7.37
7.37
7.36
7.36
7.35
7.33
7.32
7.31
7.28
7.26
7.26
7.25
7.24
7.23
5.62
5.60
5.60
5.59
3.82
3.38
3.37
3.35
3.34
3.15
3.14
3.12
3.10
0.00
N
O
O
Se
1.00
2.01
1.06
2.17
3.07
1.02
3.00
1.04
1.03
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

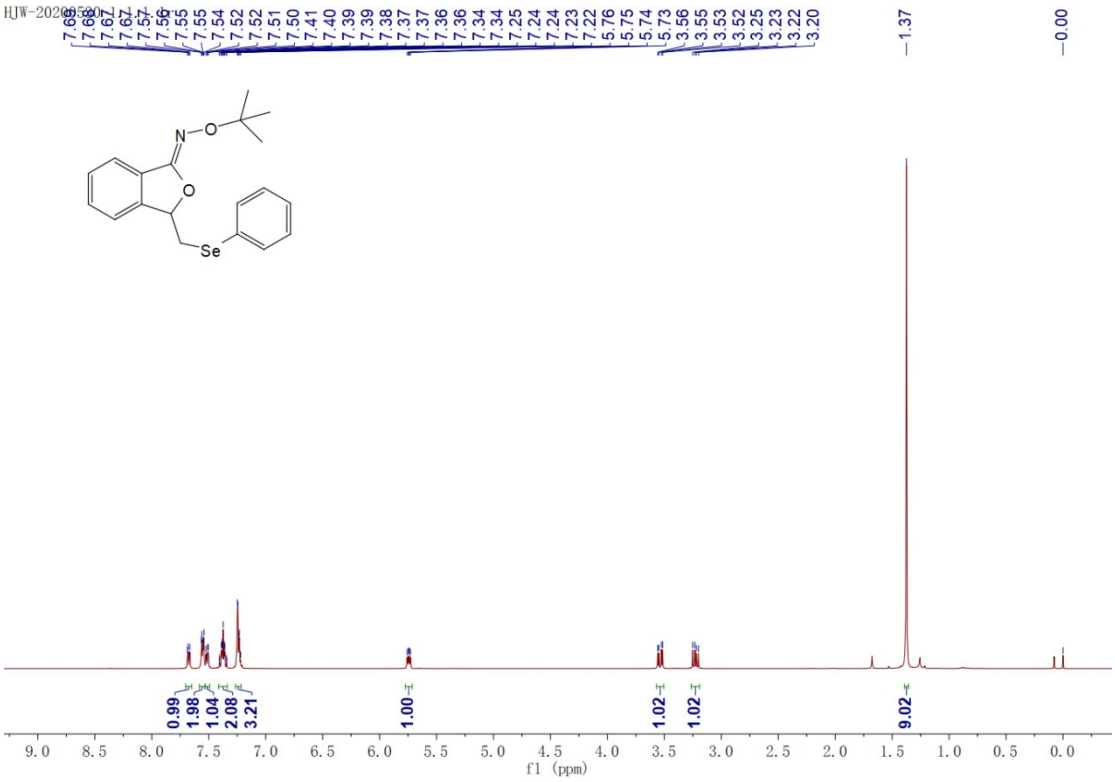

hjw-20200509-1.2.1.1r
155.66
143.28
133.47
130.65
129.20
129.15
129.12
128.86
127.56
122.19
121.59
83.91
77.61
77.29
76.97
62.70
32.19
N
O
O
Se
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

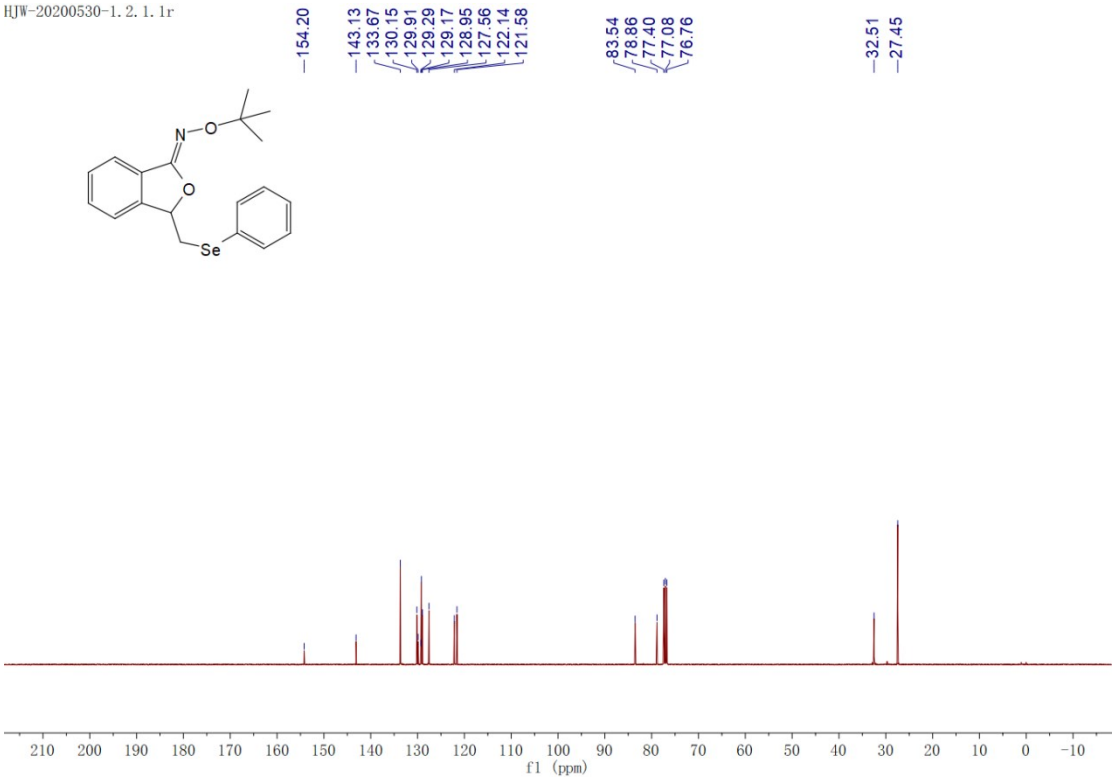
Product **3v**


7.58 7.55 7.55 7.54 7.53 7.42 7.42 7.42 7.42 7.41 7.41 7.41 7.40 7.38 7.37 7.36 7.36 7.29 7.28 7.27 7.27 7.26 7.25 7.24 7.24 7.22 7.22 7.13 7.12 7.12 7.11 7.10 7.09 7.09 7.08 5.64 5.63 5.62 5.61 4.27 4.26 4.24 4.23 4.21 3.43 3.42 3.40 3.39 3.14 3.12 3.11 3.09 1.24 1.23 0.00
N
O
O
Se
1.00 2.00 1.01 2.10 3.04 1.00 1.02 1.04 1.02 6.02
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

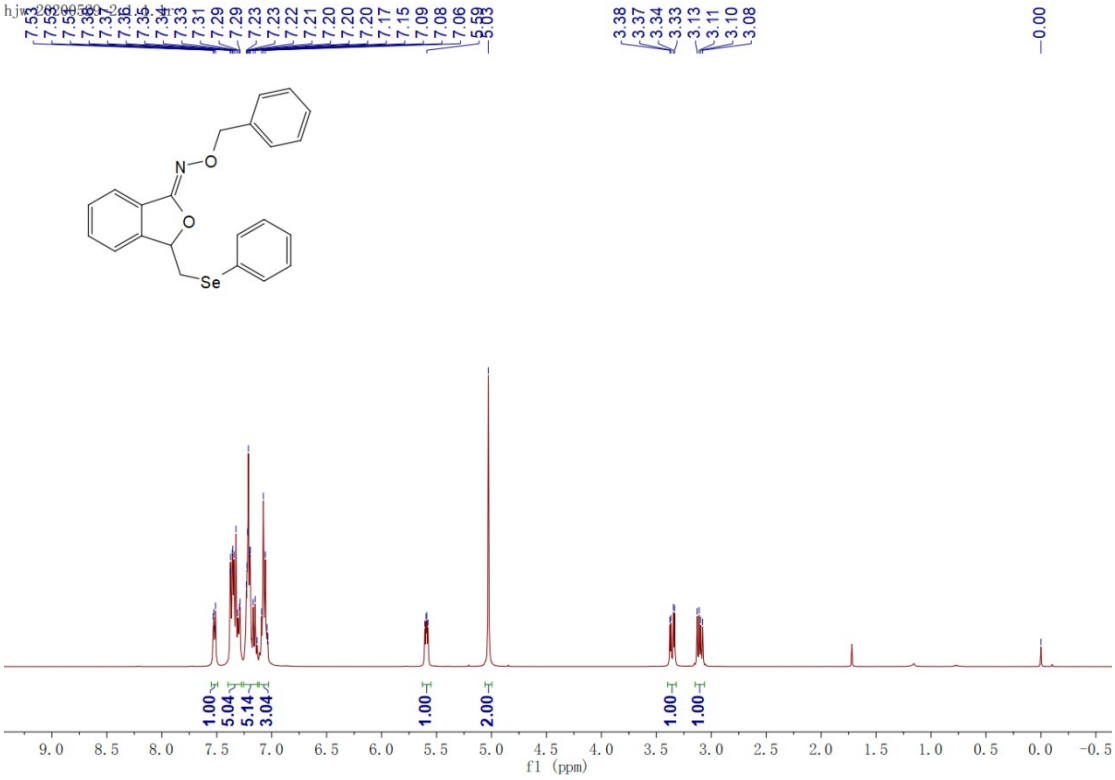

hjw-20200526-2.2.1.1r
153.86 142.12 132.57 129.29 128.35 128.12 128.09 127.96 126.49 121.09 120.47 82.59 76.46 76.15 75.83 75.03 31.36 20.55 0.00
N
O
O
Se
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

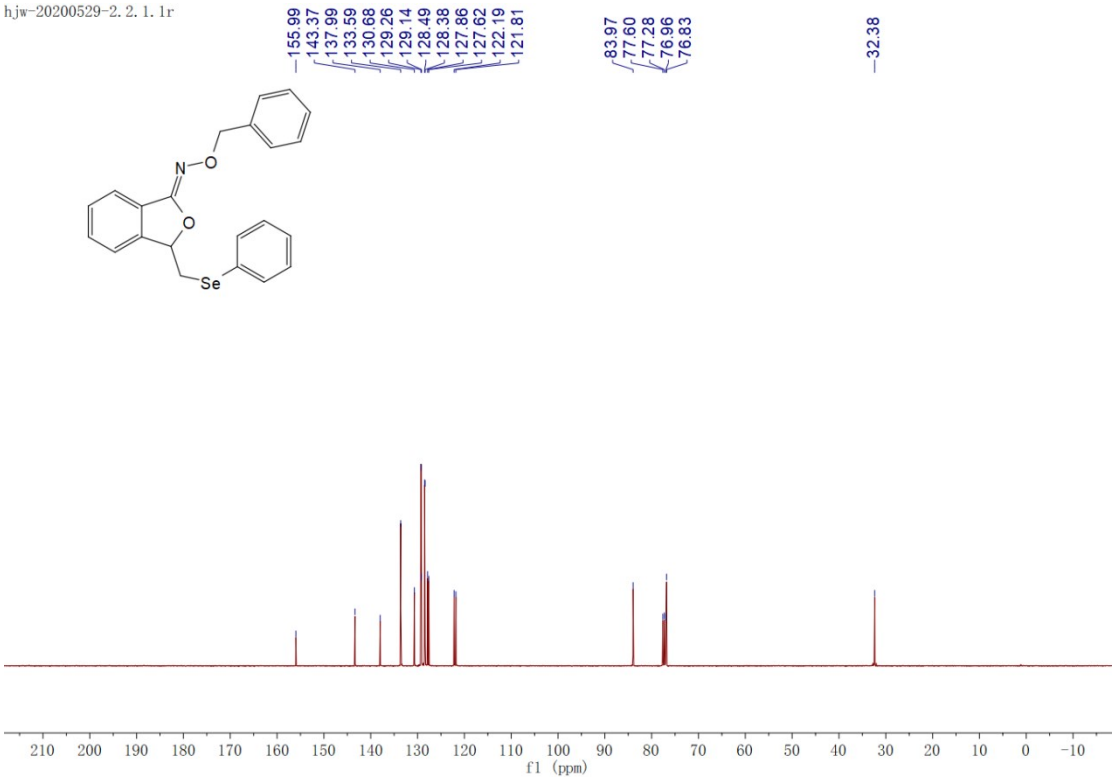
Product **3w**


HJW-20200530
7.69
7.68
7.67
7.67
7.57
7.56
7.55
7.55
7.54
7.52
7.52
7.51
7.50
7.41
7.40
7.39
7.39
7.38
7.37
7.37
7.36
7.36
7.34
7.34
7.25
7.24
7.23
7.22
5.76
5.75
5.74
5.73
3.56
3.55
3.53
3.52
3.25
3.23
3.22
3.20
1.37
0.00
N
O
O
Se
0.99
1.98
1.04
2.08
3.21
1.00
1.02
1.02
9.02
f1 (ppm)

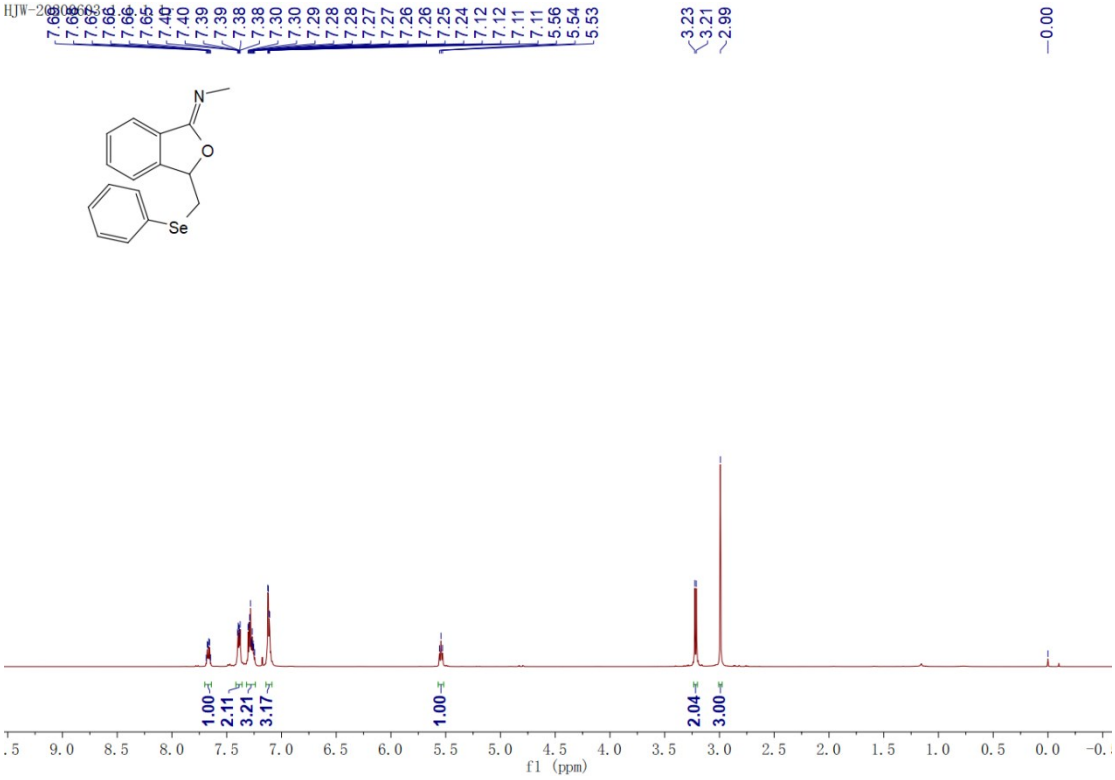

HJW-20200530-1.2.1.1r
154.20
143.13
133.67
130.15
129.91
129.29
129.17
128.95
127.56
122.14
121.58
83.54
78.86
77.40
77.08
76.76
32.51
27.45
N
O
O
Se
f1 (ppm)

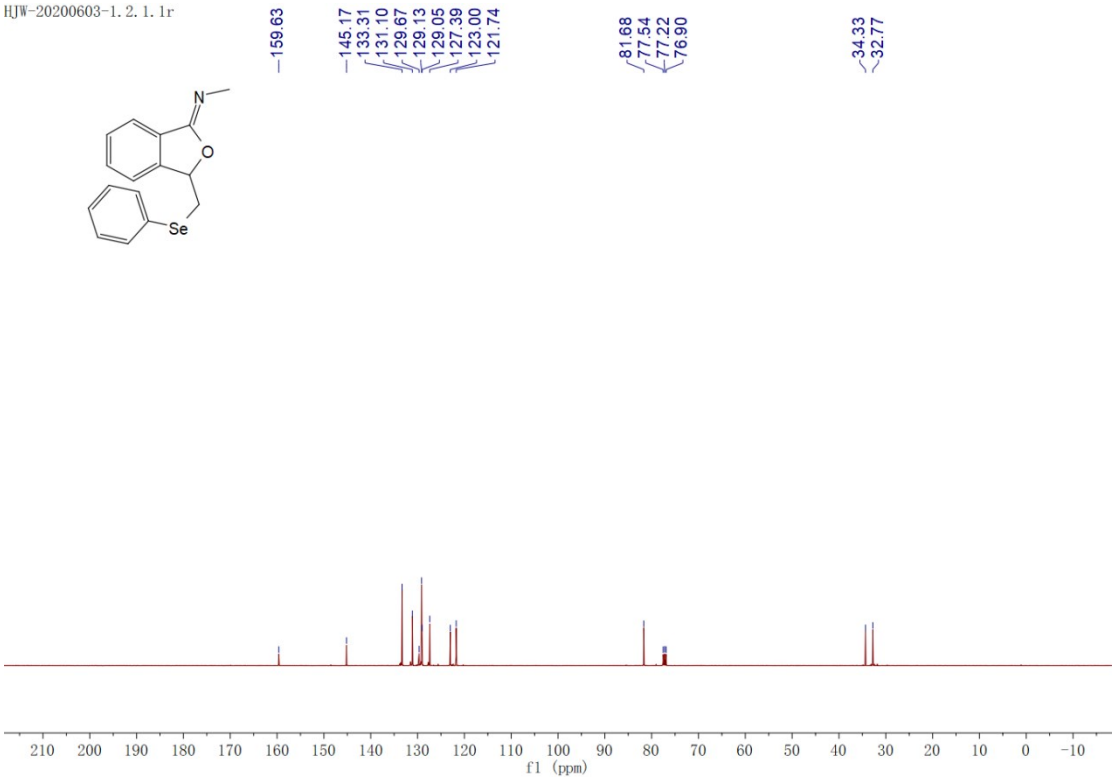
Product **3x**


7.52
7.53
7.53
7.38
7.37
7.36
7.35
7.34
7.33
7.31
7.29
7.29
7.23
7.23
7.22
7.21
7.20
7.20
7.20
7.17
7.15
7.09
7.08
7.06
5.03
3.38
3.37
3.34
3.33
3.13
3.11
3.10
3.08
0.00
N
O
O
Se
1.00
5.04
5.14
3.04
1.00
2.00
1.00
1.00
f1 (ppm)

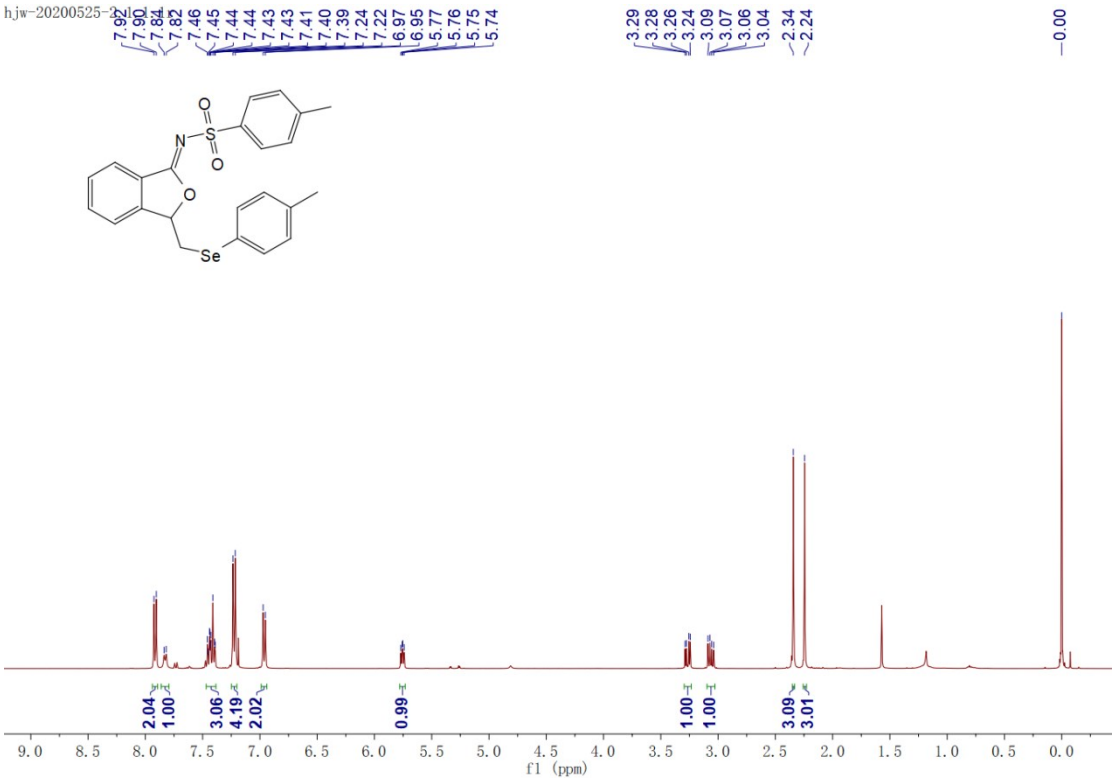

hjw-20200529-2.2.1.1r
155.99
143.37
137.99
133.59
130.68
129.26
129.14
128.49
128.38
127.86
127.62
122.19
121.81
83.97
77.60
77.28
76.96
76.83
32.38
N
O
O
Se
f1 (ppm)

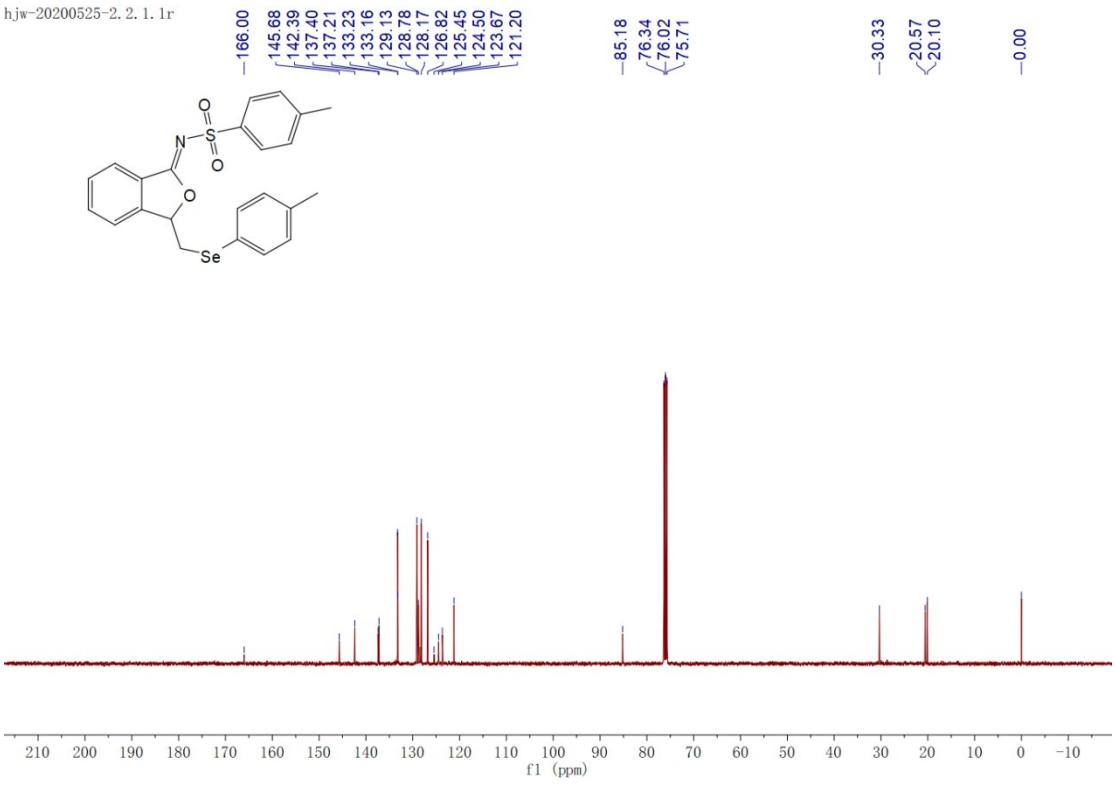
Product **3y**


7.68
7.66
7.65
7.40
7.39
7.38
7.30
7.29
7.28
7.27
7.26
7.25
7.24
7.12
7.11
5.56
5.54
5.53
3.23
3.21
2.99
0.00
N
O
Se
1.00
2.11
3.21
3.17
1.00
2.04
3.00
f1 (ppm)

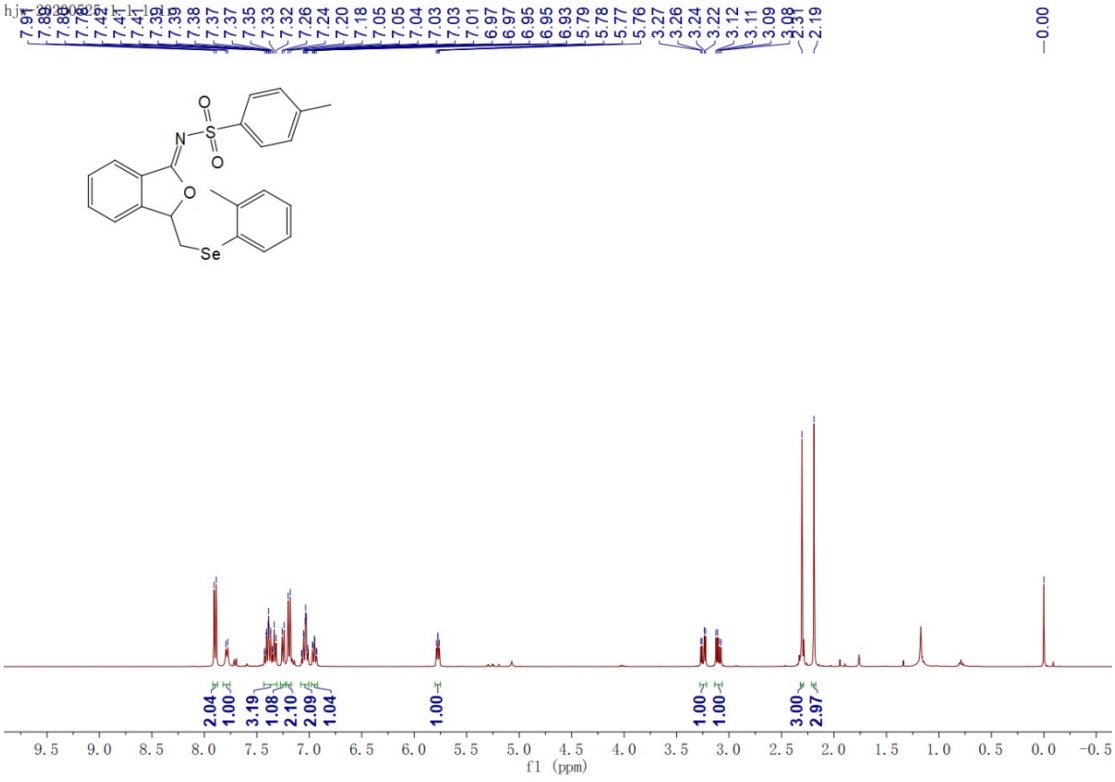

159.63
145.17
133.31
131.10
129.67
129.13
129.05
127.39
123.00
121.74
81.68
77.54
77.22
76.90
34.33
32.77
N
O
Se
f1 (ppm)

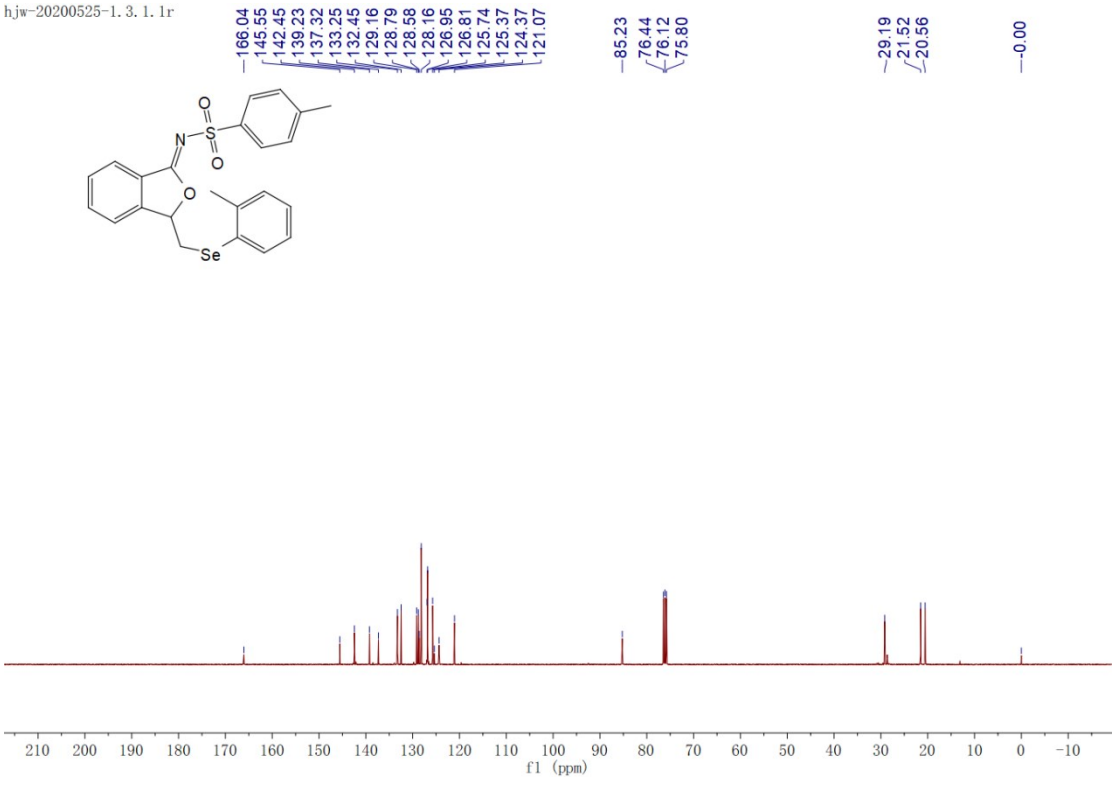
Product **3aa**


hjw-20200525-2
7.92
7.90
7.84
7.82
7.46
7.45
7.44
7.44
7.43
7.43
7.41
7.40
7.39
7.24
7.22
6.97
6.95
5.77
5.76
5.75
5.74
3.29
3.28
3.26
3.24
3.09
3.07
3.06
3.04
2.34
2.24
0.00
O
N
S
O
O
Se
2.04
1.00
3.06
4.19
2.02
0.99
1.00
1.00
3.09
3.01
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

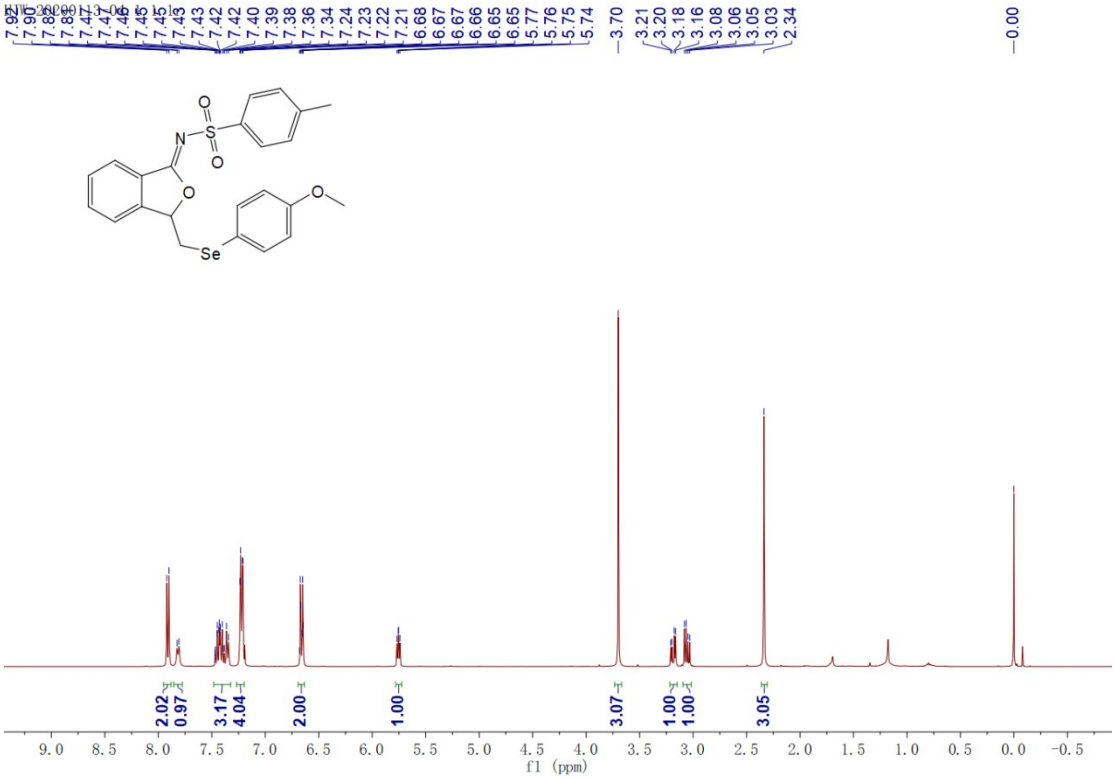

hjw-20200525-2.2.1.1r
166.00
145.68
142.39
137.40
137.21
133.23
133.16
129.13
128.78
128.17
126.82
125.45
124.50
123.67
121.20
85.18
76.34
76.02
75.71
30.33
20.57
20.10
0.00
O
N
S
O
O
Se
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 −10
f1 (ppm)

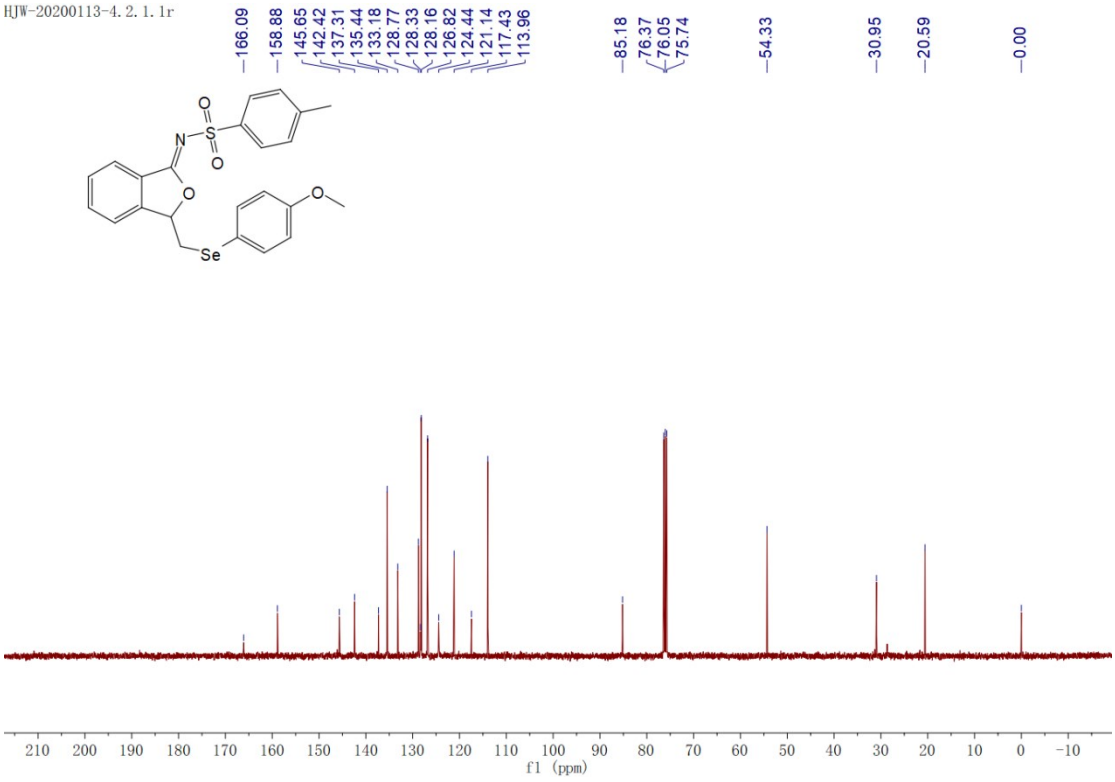
Product **3ab**


7.91
7.88
7.80
7.78
7.42
7.41
7.39
7.38
7.37
7.35
7.33
7.32
7.26
7.24
7.20
7.18
7.05
7.04
7.03
7.01
6.97
6.95
6.93
5.79
5.78
5.77
5.76
3.27
3.26
3.24
3.22
3.12
3.11
3.09
2.19
0.00
O
N
S
O
O
Se
2.04
1.00
3.19
1.08
2.10
2.09
1.04
1.00
1.00
1.00
3.00
2.97
f1 (ppm)

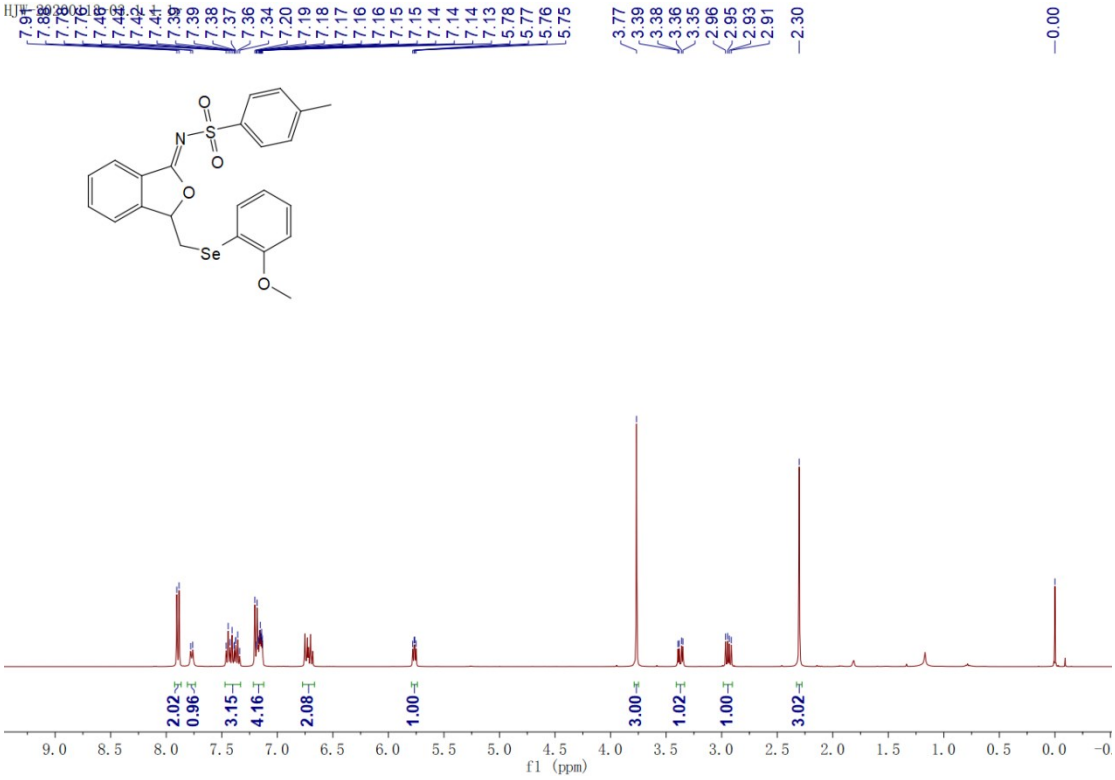

hjw-20200525-1.3.1.1r
166.04
145.55
142.45
139.23
137.32
133.25
132.45
129.16
128.79
128.58
128.16
126.95
126.81
125.74
125.37
124.37
121.07
85.23
76.44
76.12
75.80
29.19
21.52
20.56
0.00
O
N
S
O
O
Se
f1 (ppm)

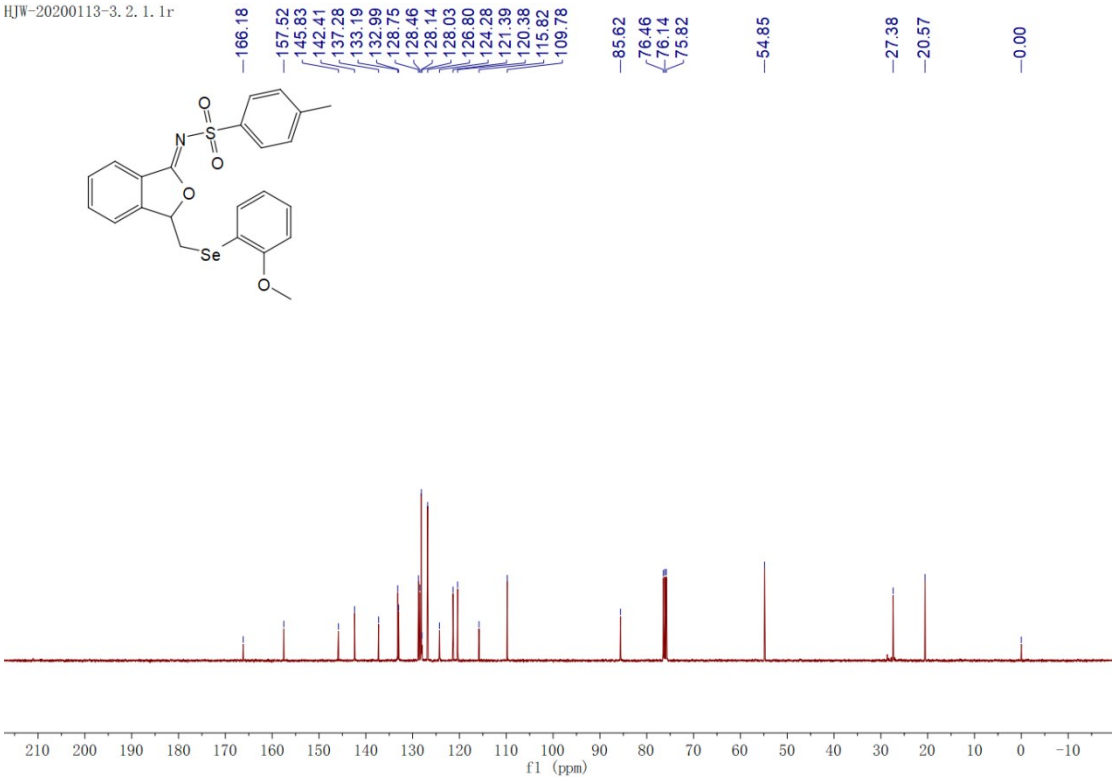
Product **3ac**


7.92
7.90
7.88
7.87
7.47
7.46
7.45
7.43
7.42
7.40
7.39
7.38
7.36
7.34
7.24
7.23
7.22
7.21
6.68
6.67
6.67
6.66
6.65
6.65
5.77
5.76
5.75
5.74
3.70
3.21
3.20
3.18
3.16
3.08
3.06
3.05
3.03
2.34
0.00
O
N
S
O
O
O
Se
2.02
0.97
3.17
4.04
2.00
1.00
3.07
1.00
1.00
3.05
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

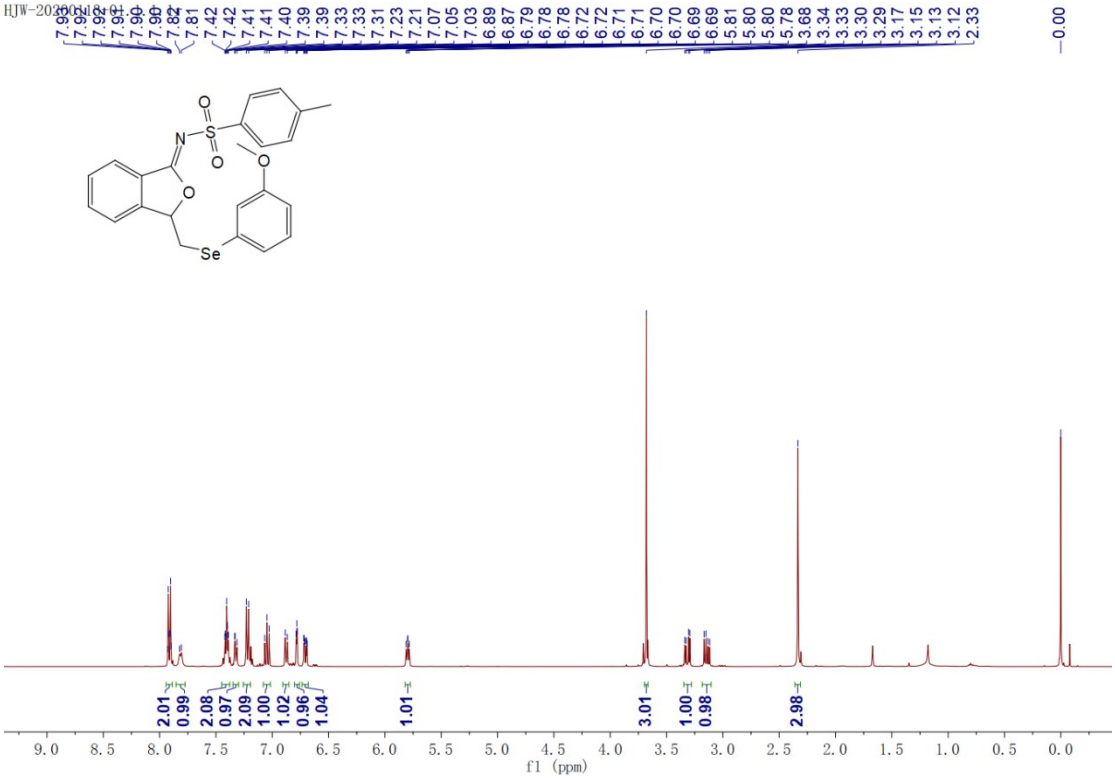

HJW-20200113-4.2.1.1r
166.09
158.88
145.65
142.42
137.31
135.44
133.18
128.77
128.33
128.16
126.82
124.44
121.14
117.43
113.96
85.18
76.37
76.05
75.74
54.33
30.95
20.59
0.00
O
N
S
O
O
O
Se
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

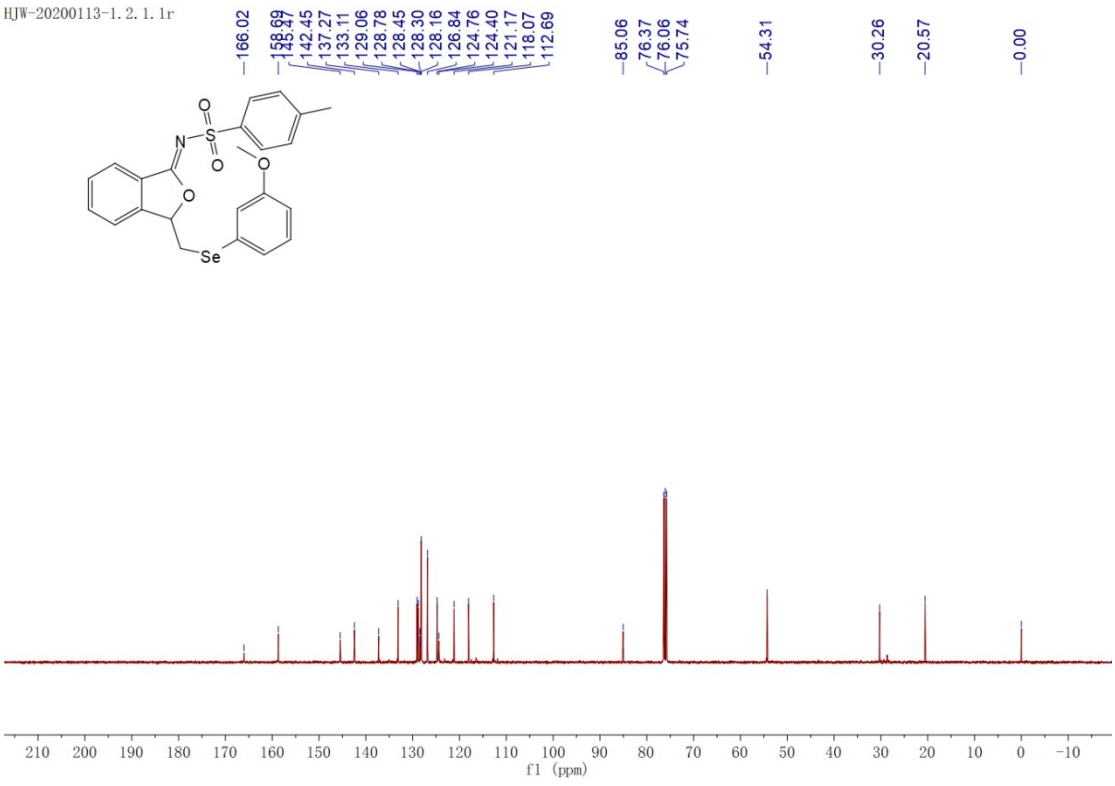
Product **3ad**


7.94
7.88
7.76
7.46
7.44
7.42
7.41
7.39
7.39
7.38
7.37
7.36
7.34
7.20
7.19
7.18
7.17
7.16
7.16
7.15
7.15
7.14
7.14
7.14
7.13
5.78
5.77
5.76
5.75
3.77
3.39
3.38
3.36
3.35
2.96
2.95
2.93
2.91
2.30
0.00
O
N
S
O
O
Se
O
2.02
0.96
3.15
4.16
2.08
1.00
3.00
1.02
1.00
3.02
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

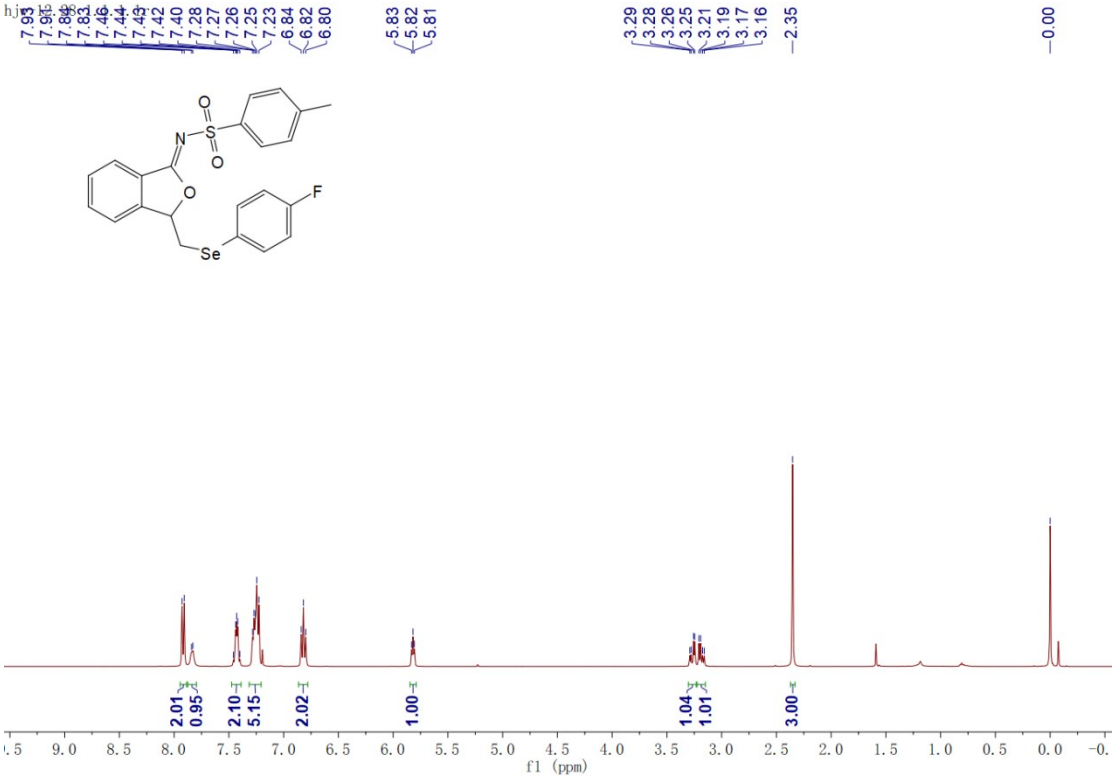

HJW-20200113-3.2.1.1r
166.18
157.52
145.83
142.41
137.28
133.19
132.99
128.75
128.46
128.14
128.03
126.80
124.28
121.39
120.38
115.82
109.78
85.62
76.46
76.14
75.82
54.85
27.38
20.57
0.00
O
N
S
O
O
Se
O
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

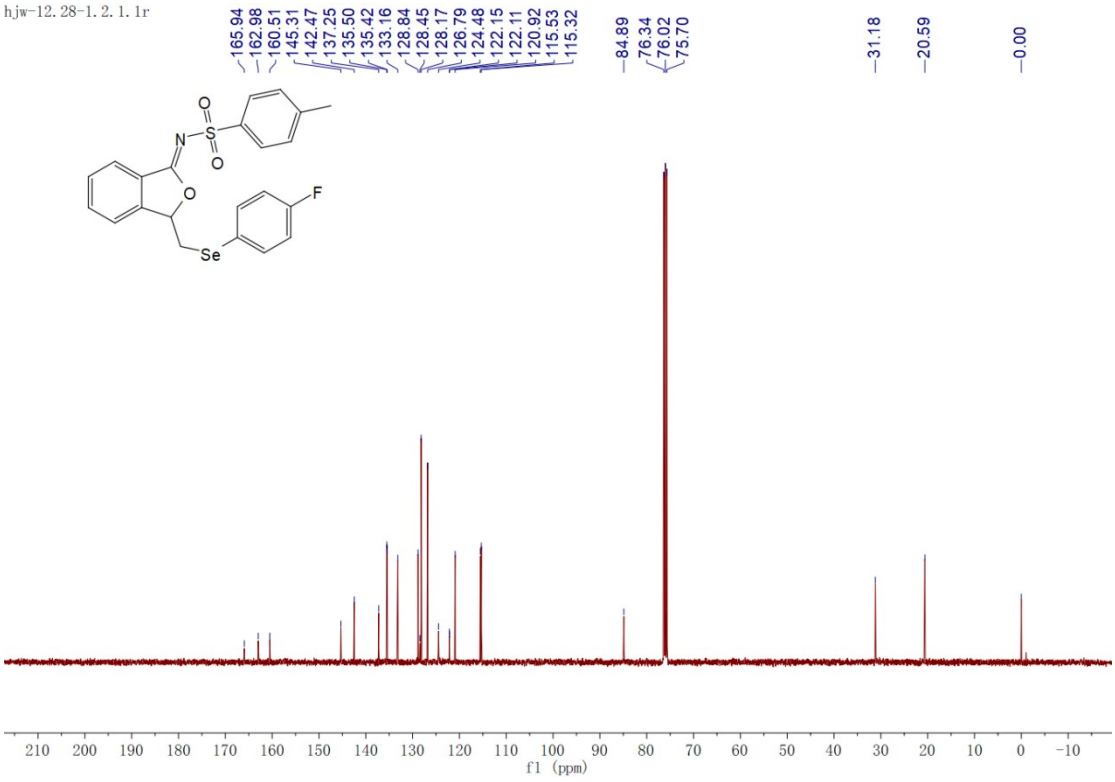
Product **3ae**


HJW-20200113-1.1.1r
7.99
7.98
7.96
7.94
7.90
7.90
7.82
7.81
7.42
7.42
7.41
7.41
7.40
7.39
7.39
7.33
7.33
7.31
7.23
7.21
7.07
7.05
7.03
6.89
6.87
6.79
6.78
6.78
6.72
6.72
6.71
6.71
6.70
6.70
6.69
6.69
5.81
5.80
5.80
5.78
3.68
3.34
3.33
3.30
3.29
3.17
3.15
3.13
3.12
2.33
0.00
O
N
S
O
O
O
Se
2.01
0.99
2.08
0.97
2.09
1.00
1.02
0.96
1.04
1.01
3.01
1.00
0.98
2.98
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

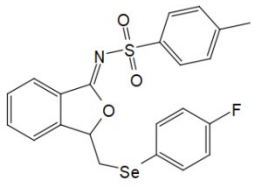

HJW-20200113-1.2.1.1r
166.02
158.69
145.47
142.45
137.27
133.11
129.06
128.78
128.45
128.30
128.16
126.84
124.76
124.40
121.17
118.07
112.69
85.06
76.37
76.06
75.74
54.31
30.26
20.57
0.00
O
N
S
O
O
O
Se
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

Product **3af**

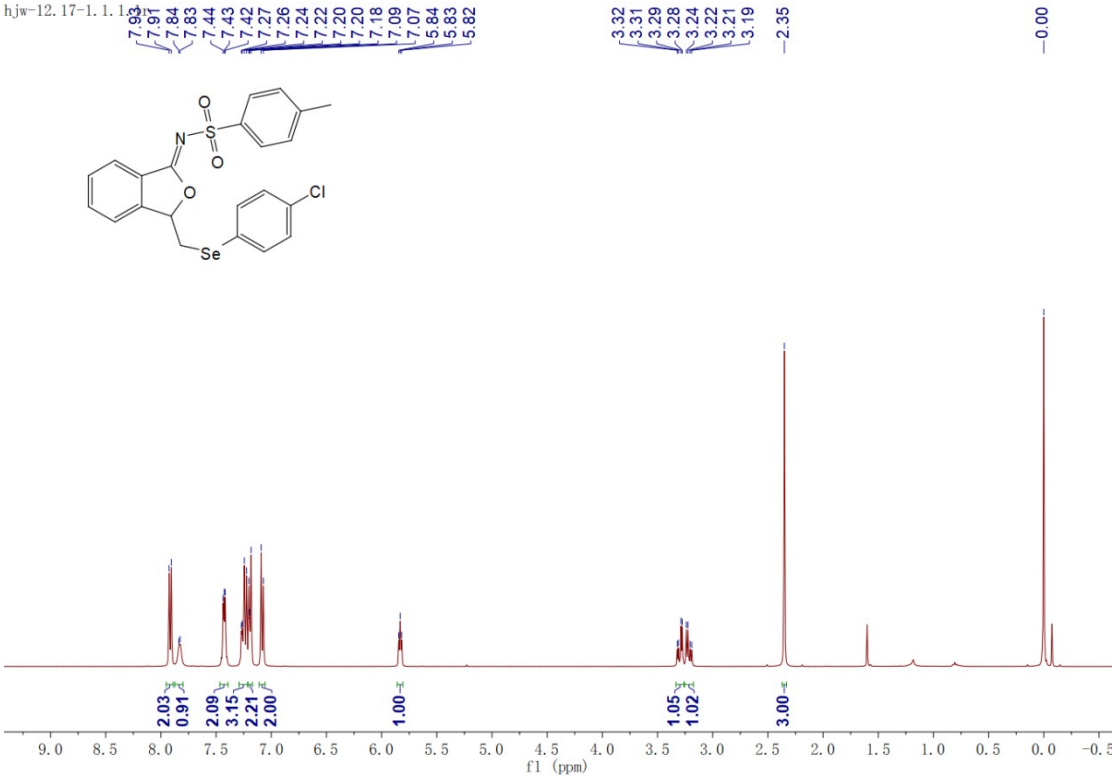

7.95
7.84
7.83
7.46
7.44
7.43
7.42
7.40
7.28
7.27
7.26
7.25
7.23
6.84
6.82
6.80
5.83
5.82
5.81
3.29
3.28
3.26
3.25
3.21
3.19
3.17
3.16
2.35
0.00
O
N
S
O
O
F
Se
2.01
0.95
2.10
5.15
2.02
1.00
1.04
1.01
3.00
f1 (ppm)

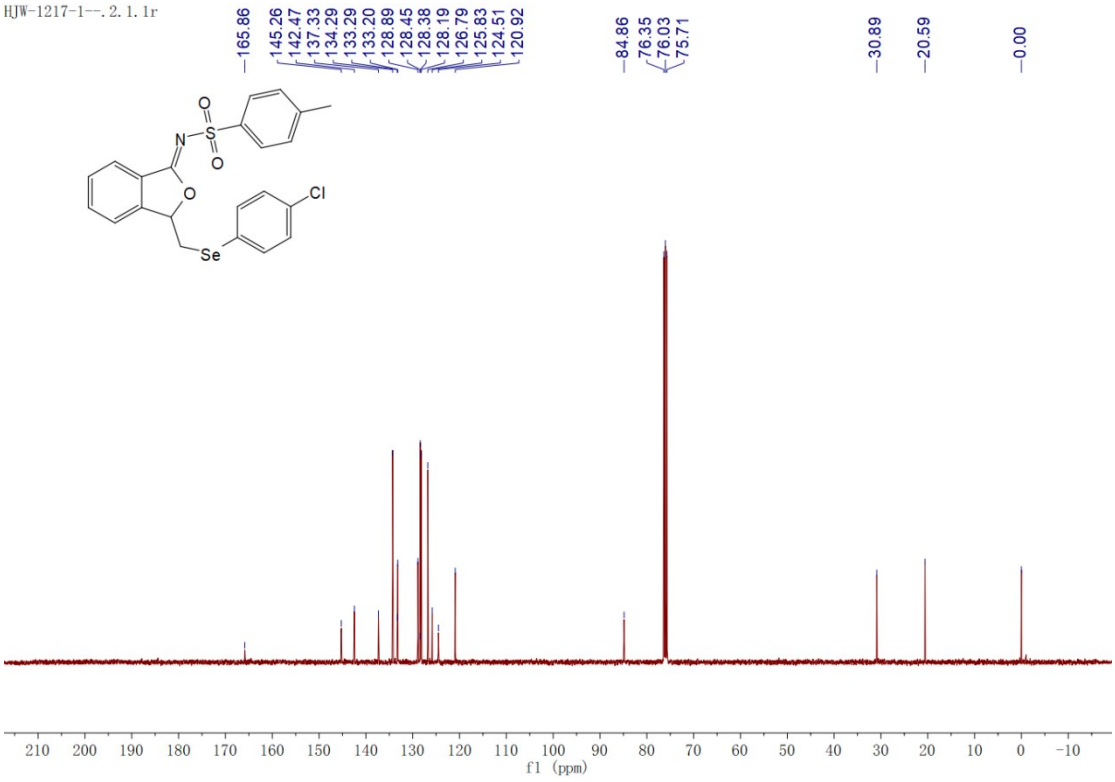

hjw-12.28-1.2.1.1r
165.94
162.98
160.51
145.31
142.47
137.25
135.50
135.42
133.16
128.84
128.45
128.17
126.79
124.48
122.15
122.11
120.92
115.53
115.32
84.89
76.34
76.02
75.70
31.18
20.59
0.00
O
N
S
O
O
F
Se
f1 (ppm)

HJW-1228-1.7.1.1r

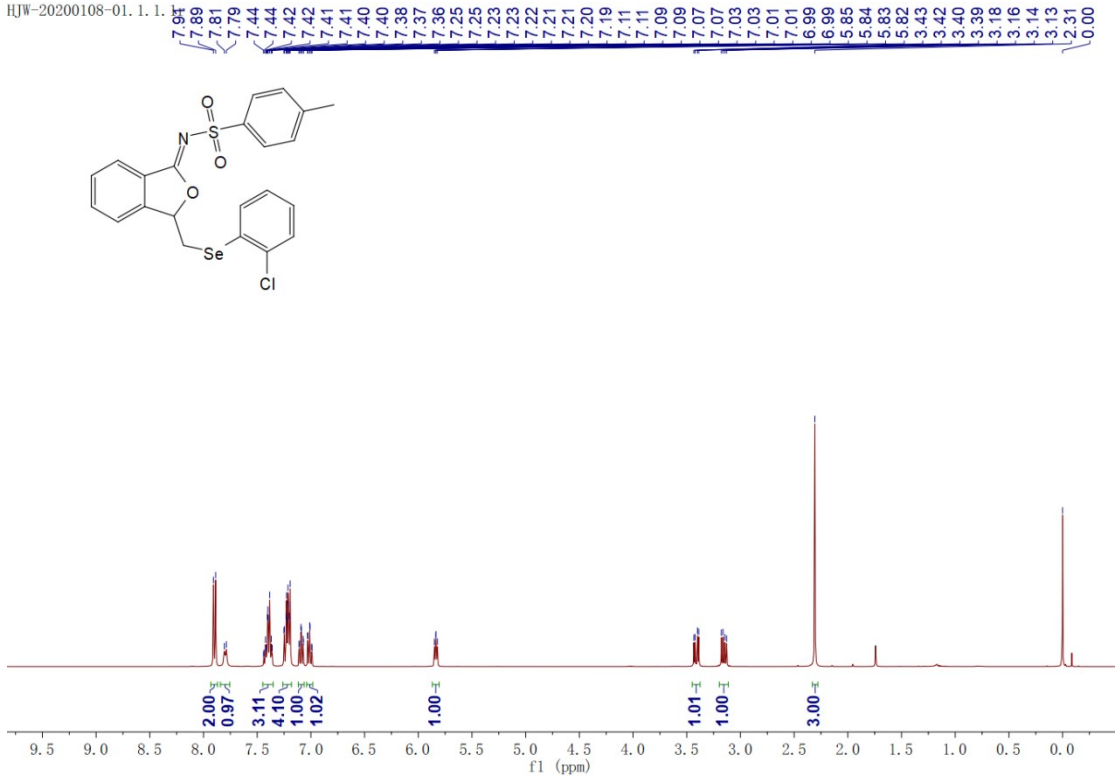


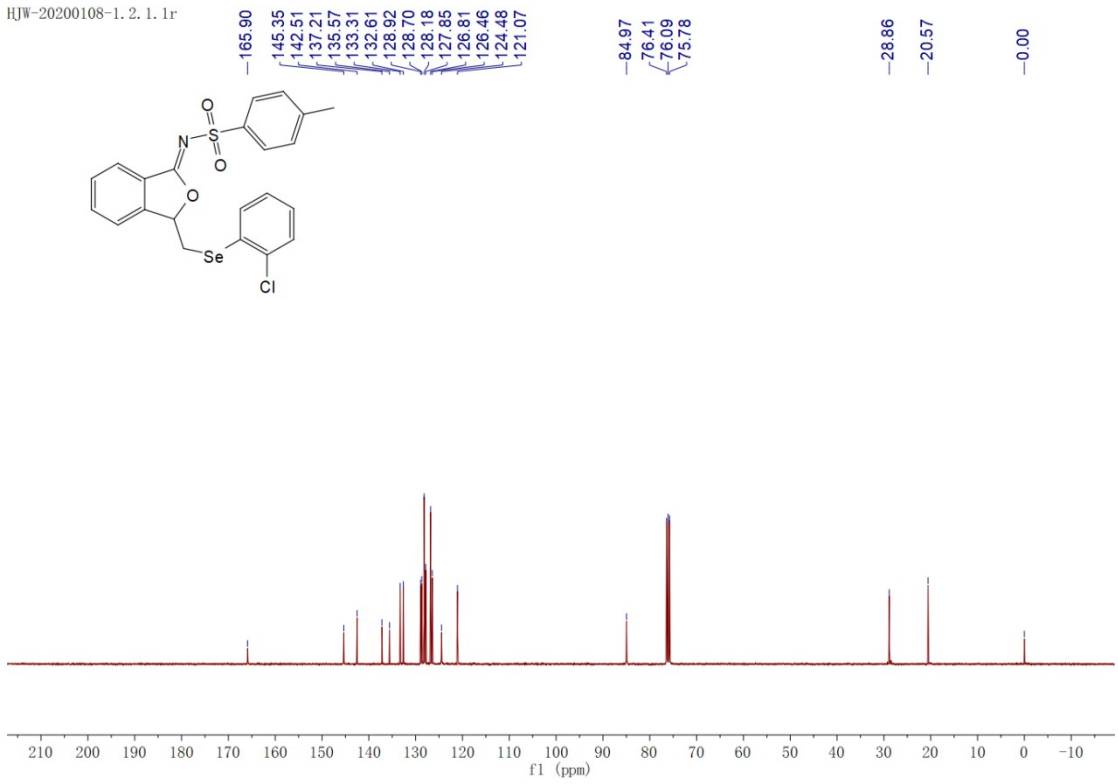
Product **3ag**


hjw-12.17-1.1.1s
7.93
7.91
7.84
7.83
7.44
7.43
7.42
7.27
7.26
7.24
7.22
7.20
7.18
7.09
7.07
5.84
5.83
5.82
3.32
3.31
3.29
3.28
3.24
3.22
3.21
3.19
2.35
0.00
O
N
S
O
O
Cl
Se
2.03
0.91
2.09
3.15
2.21
2.00
1.00
1.05
1.02
3.00
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

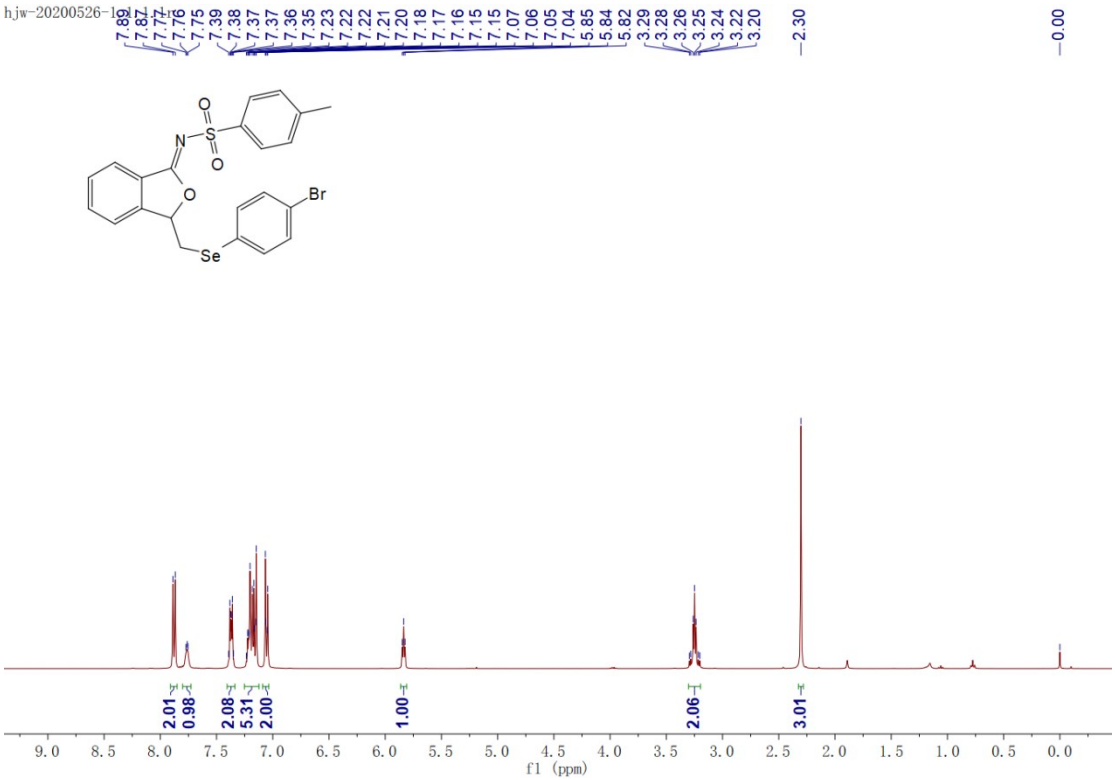

HJW-1217-1--.2.1.1r
165.86
145.26
142.47
137.33
134.29
133.29
133.20
128.89
128.45
128.38
128.19
126.79
125.83
124.51
120.92
84.86
76.35
76.03
75.71
30.89
20.59
0.00
O
N
S
O
O
Cl
Se
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

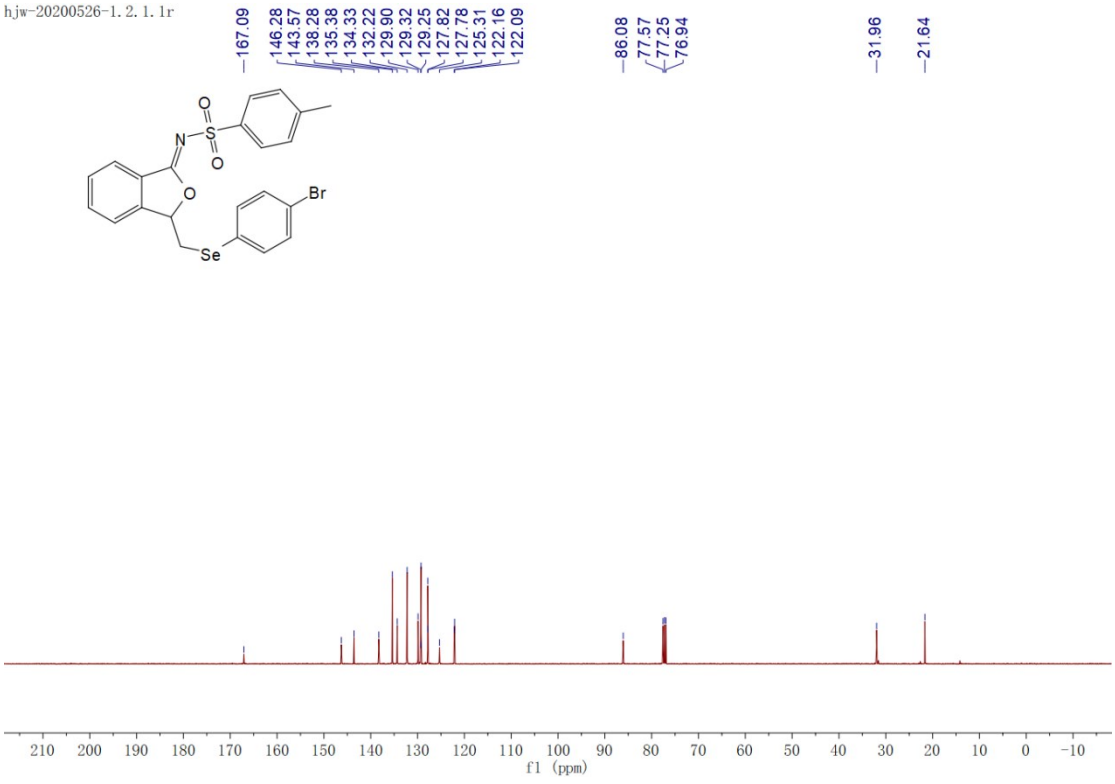
Product **3ah**


HJW-20200108-01.1.1.
7.94
7.89
7.81
7.79
7.44
7.44
7.42
7.42
7.41
7.41
7.40
7.40
7.38
7.37
7.36
7.25
7.25
7.23
7.23
7.22
7.21
7.21
7.20
7.19
7.11
7.11
7.09
7.09
7.07
7.07
7.03
7.03
7.01
7.01
6.99
6.99
5.85
5.84
5.83
5.82
3.43
3.42
3.40
3.39
3.18
3.16
3.14
3.13
2.31
0.00
O
N
S
O
O
Se
Cl
2.00
0.97
3.11
4.10
1.00
1.02
1.00
1.01
1.00
3.00
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

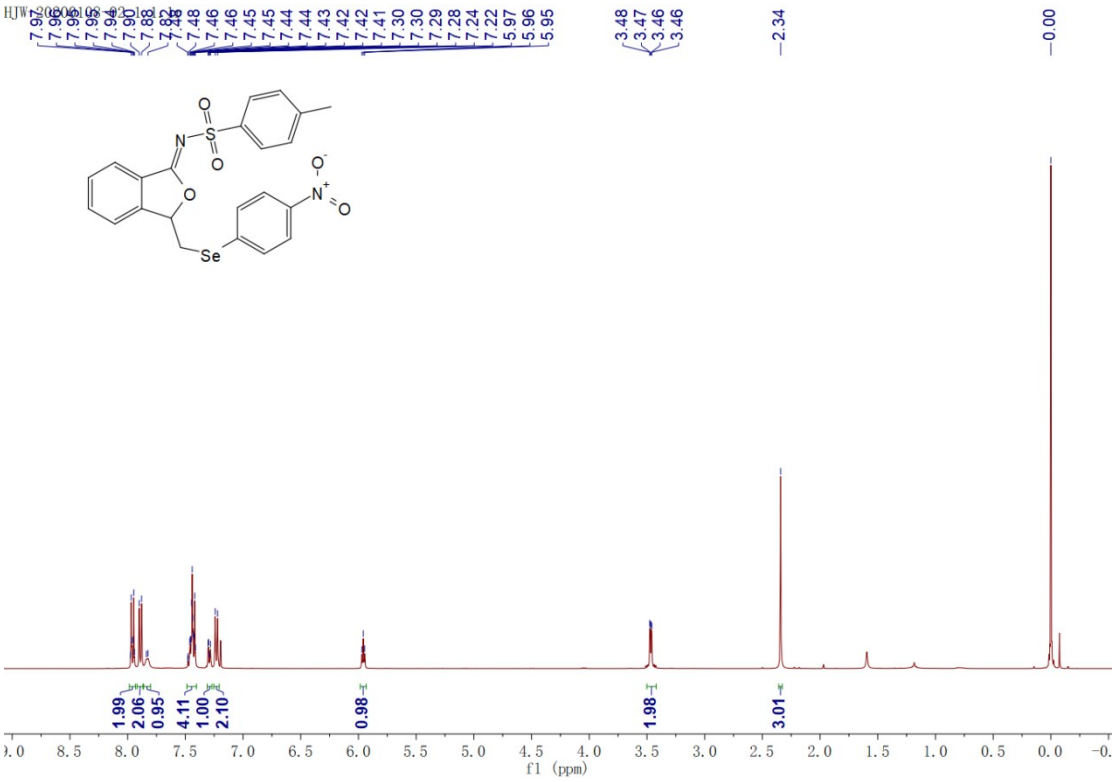

HJW-20200108-1.2.1.1r
165.90
145.35
142.51
137.21
135.57
133.31
132.61
128.92
128.70
128.18
127.85
126.81
126.46
124.48
121.07
84.97
76.41
76.09
75.78
28.86
20.57
0.00
O
N
S
O
O
Se
Cl
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

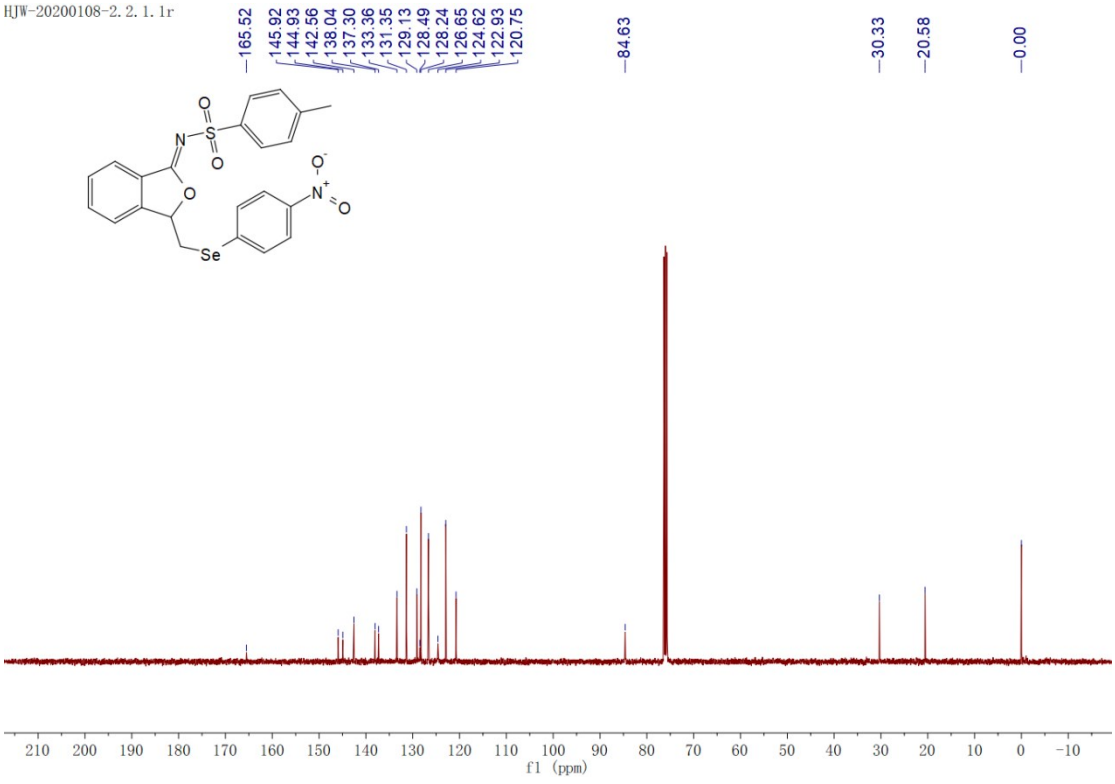
Product **3ai**


hjw-20200526-1
7.89
7.87
7.77
7.76
7.75
7.39
7.38
7.37
7.37
7.36
7.35
7.23
7.22
7.22
7.21
7.20
7.18
7.17
7.16
7.15
7.15
7.07
7.06
7.05
7.04
5.85
5.84
5.82
3.29
3.28
3.26
3.25
3.24
3.22
3.20
2.30
0.00
O
N
S
O
O
Br
Se
2.01
0.98
2.08
5.31
2.00
1.00
2.06
3.01
f1 (ppm)

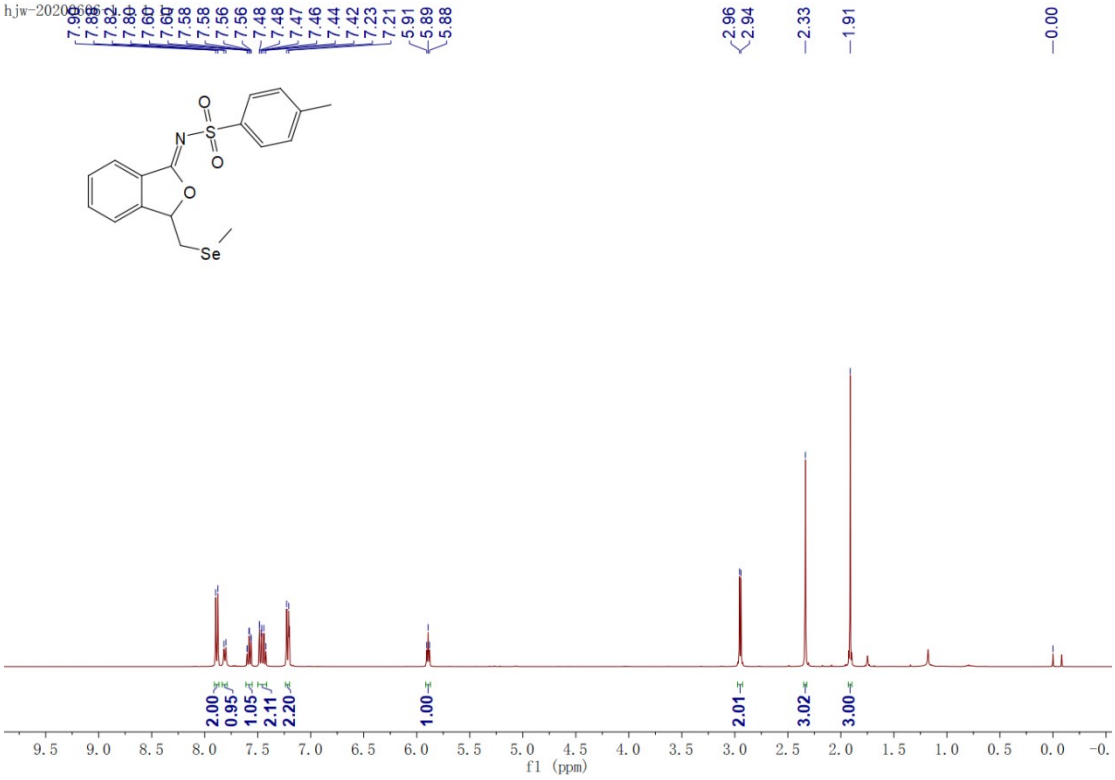

hjw-20200526-1.2.1.1r
167.09
146.28
143.57
138.28
135.38
134.33
132.22
129.90
129.32
129.25
127.82
127.78
125.31
122.16
122.09
86.08
77.57
77.25
76.94
31.96
21.64
O
N
S
O
O
Br
Se
f1 (ppm)

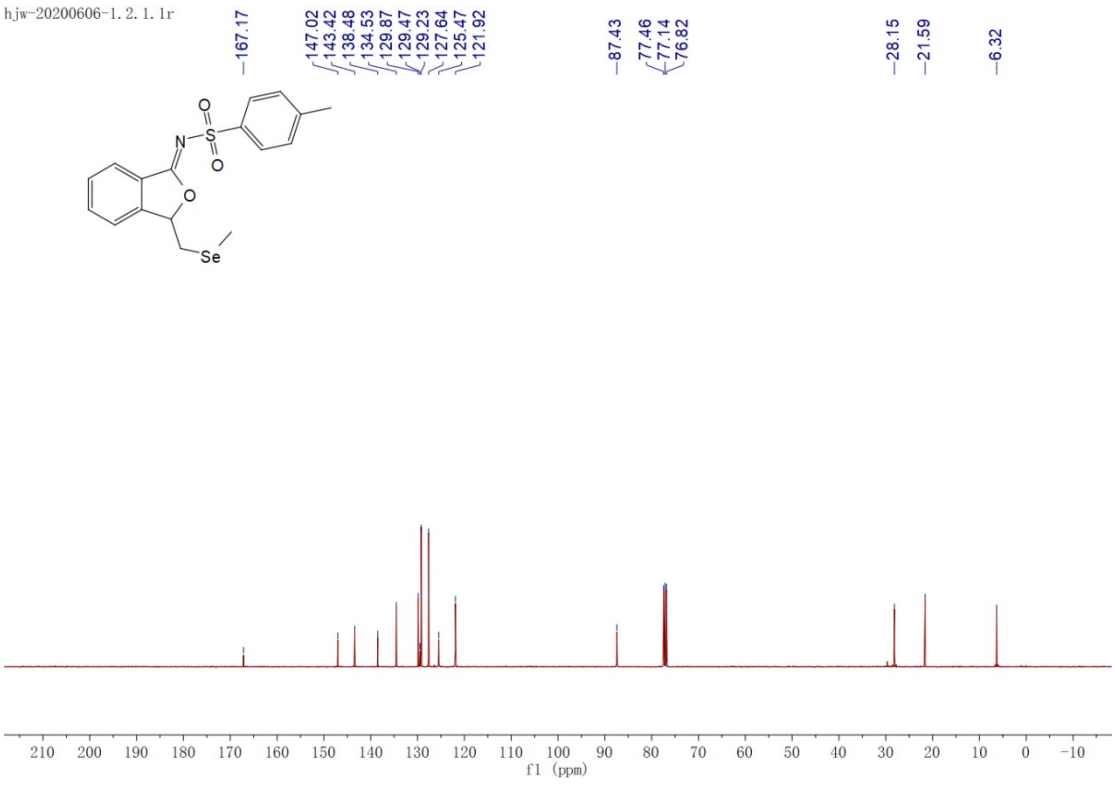
Product **3aj**


7.97
7.96
7.96
7.95
7.94
7.90
7.88
7.82
7.48
7.46
7.46
7.45
7.45
7.44
7.44
7.43
7.42
7.42
7.41
7.30
7.30
7.29
7.28
7.24
7.22
5.97
5.96
5.95
3.48
3.47
3.46
3.46
2.34
0.00
1.99
2.06
0.95
4.11
1.00
2.10
0.98
1.98
3.01
f1 (ppm)

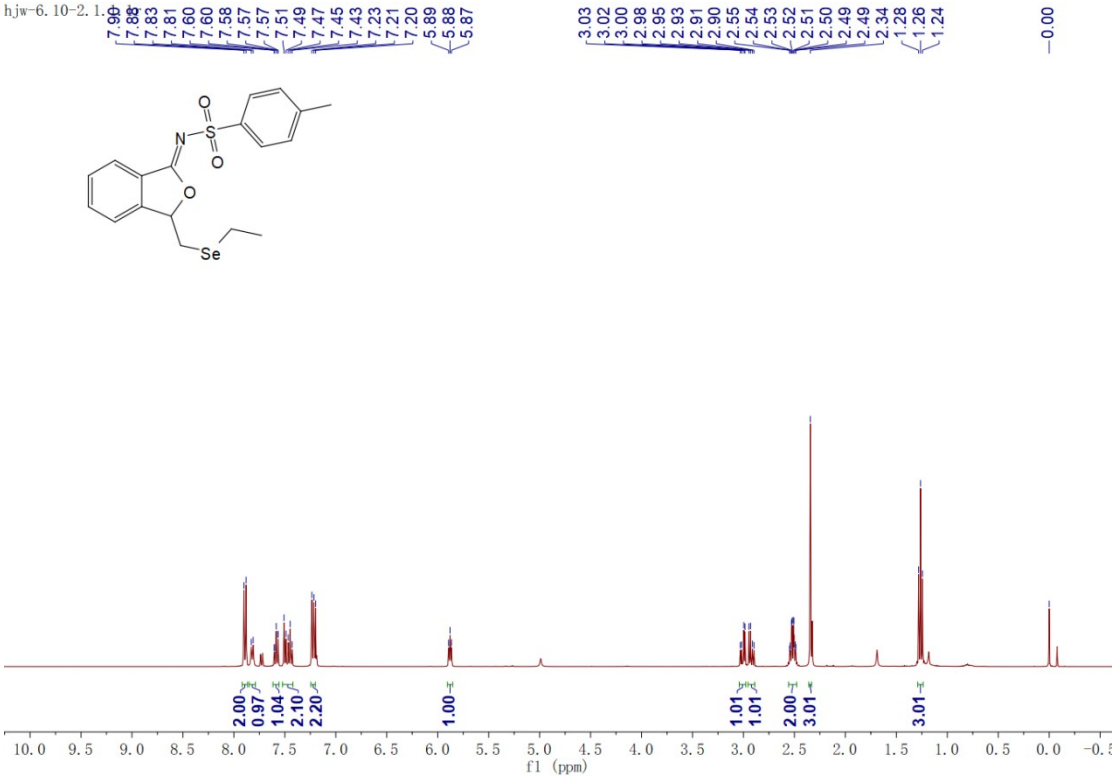

HJW-20200108-2.2.1.1r
165.52
145.92
144.93
142.56
138.04
137.30
133.36
131.35
129.13
128.49
128.24
126.65
124.62
122.93
120.75
84.63
30.33
20.58
0.00
f1 (ppm)

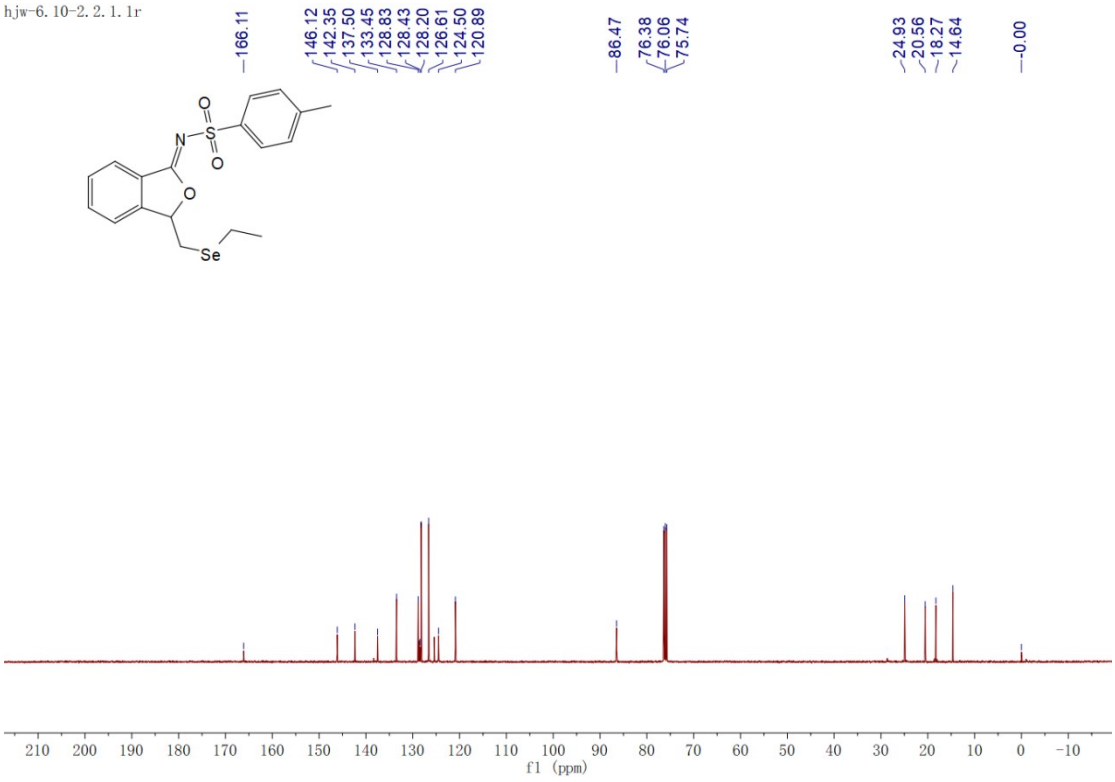
Product **3ak**


7.96
7.88
7.82
7.80
7.60
7.60
7.58
7.58
7.56
7.56
7.48
7.48
7.47
7.46
7.44
7.42
7.23
7.21
5.91
5.89
5.88
2.96
2.94
2.33
1.91
0.00
O
N
S
O
O
Se
2.00
0.95
1.05
2.11
2.20
1.00
2.01
3.02
3.00
f1 (ppm)

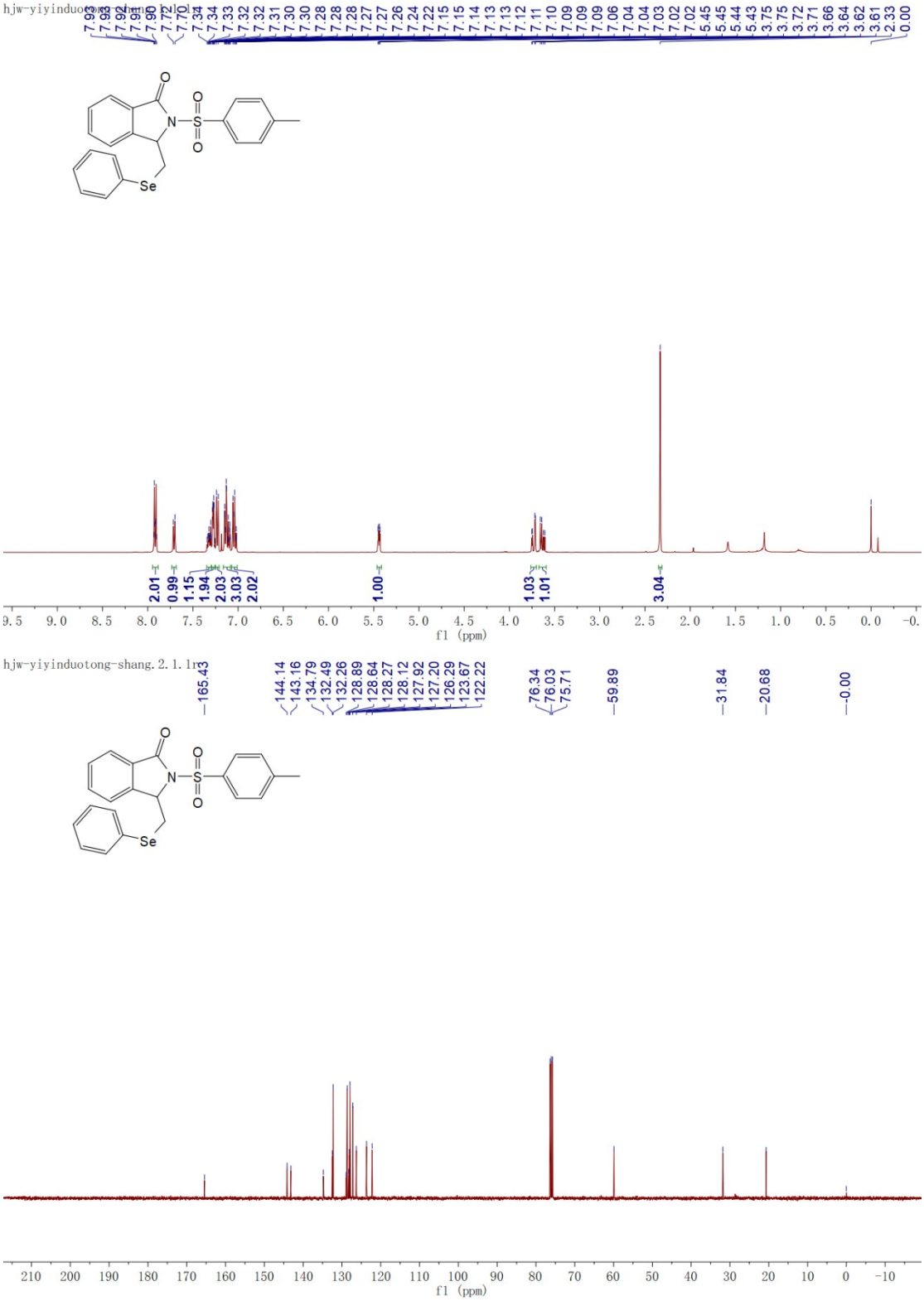

hjw-20200606-1.2.1.1r
167.17
147.02
143.42
138.48
134.53
129.87
129.47
129.23
127.64
125.47
121.92
87.43
77.46
77.14
76.82
28.15
21.59
6.32
O
N
S
O
O
Se
f1 (ppm)

Product **3al**

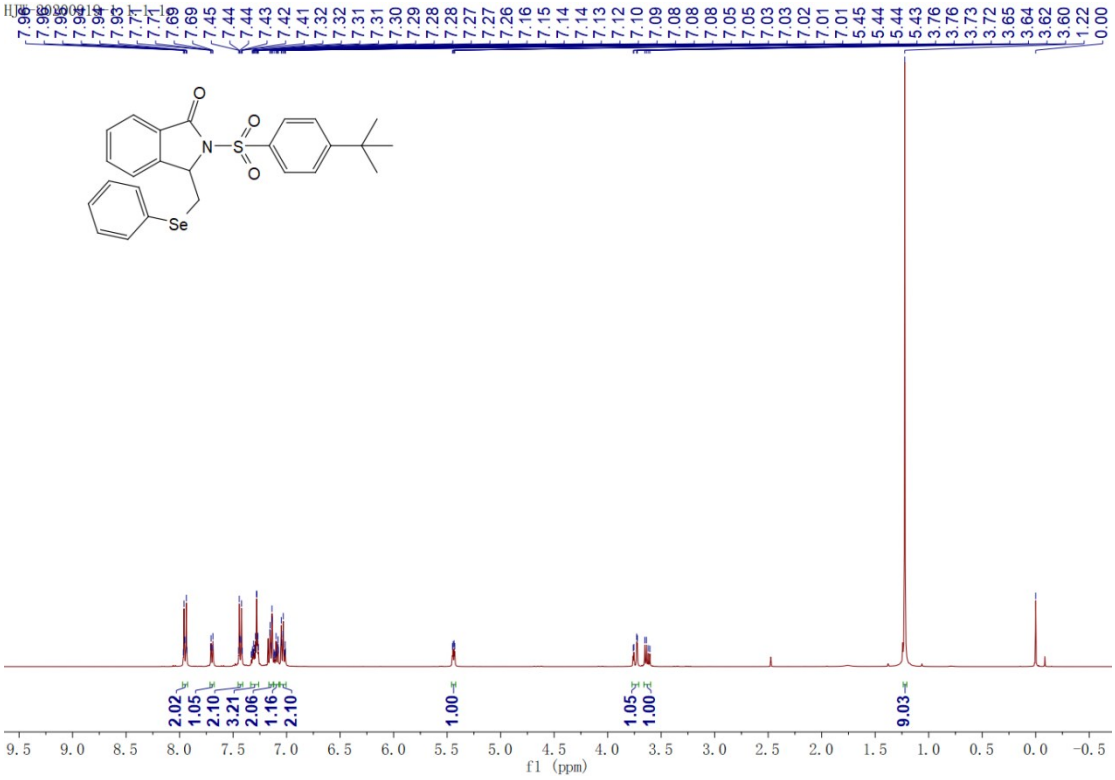

hjw-6.10-2.1.1r
7.96
7.88
7.83
7.81
7.60
7.60
7.58
7.57
7.57
7.51
7.49
7.47
7.45
7.43
7.23
7.21
7.20
5.89
5.88
5.87
3.03
3.02
3.00
2.98
2.95
2.93
2.91
2.90
2.55
2.54
2.53
2.52
2.51
2.50
2.49
2.34
1.28
1.26
1.24
0.00
O
N
S
O
O
Se
2.00
0.97
1.04
2.10
2.20
1.00
1.01
1.01
2.00
3.01
3.01
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

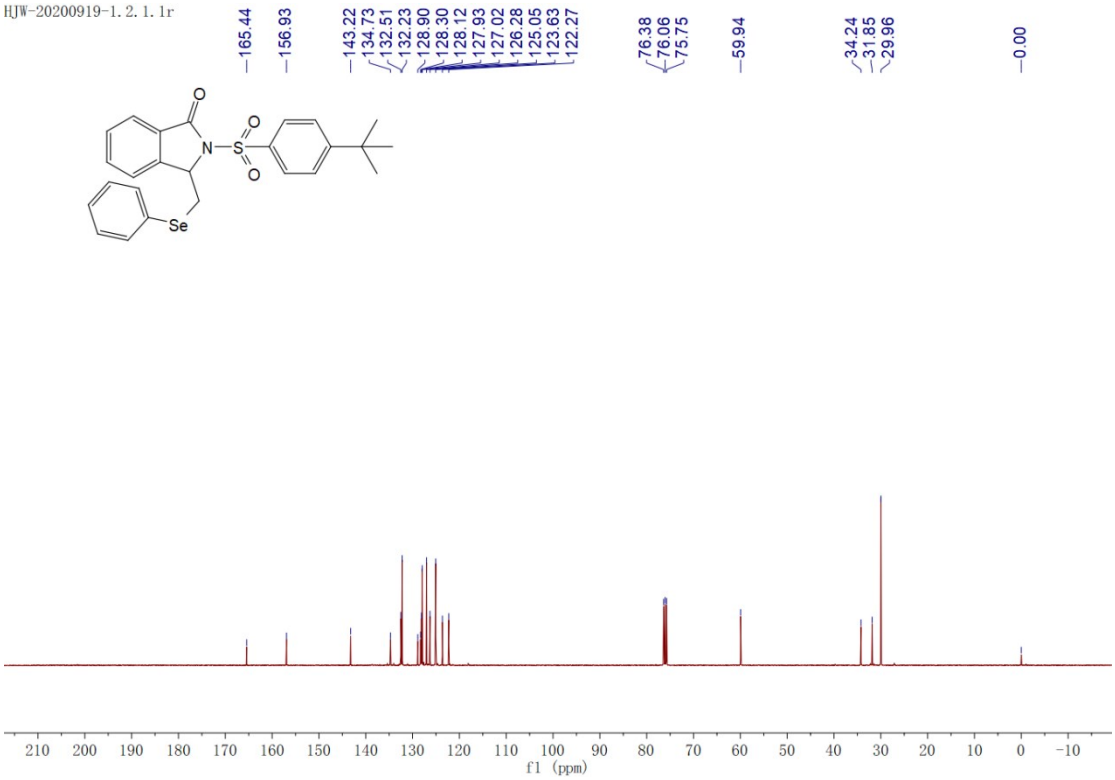

hjw-6.10-2.2.1.1r
166.11
146.12
142.35
137.50
133.45
128.83
128.43
128.20
126.61
124.50
120.89
86.47
76.38
76.06
75.74
24.93
20.56
18.27
14.64
0.00
O
N
S
O
O
Se
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

Product **4a**

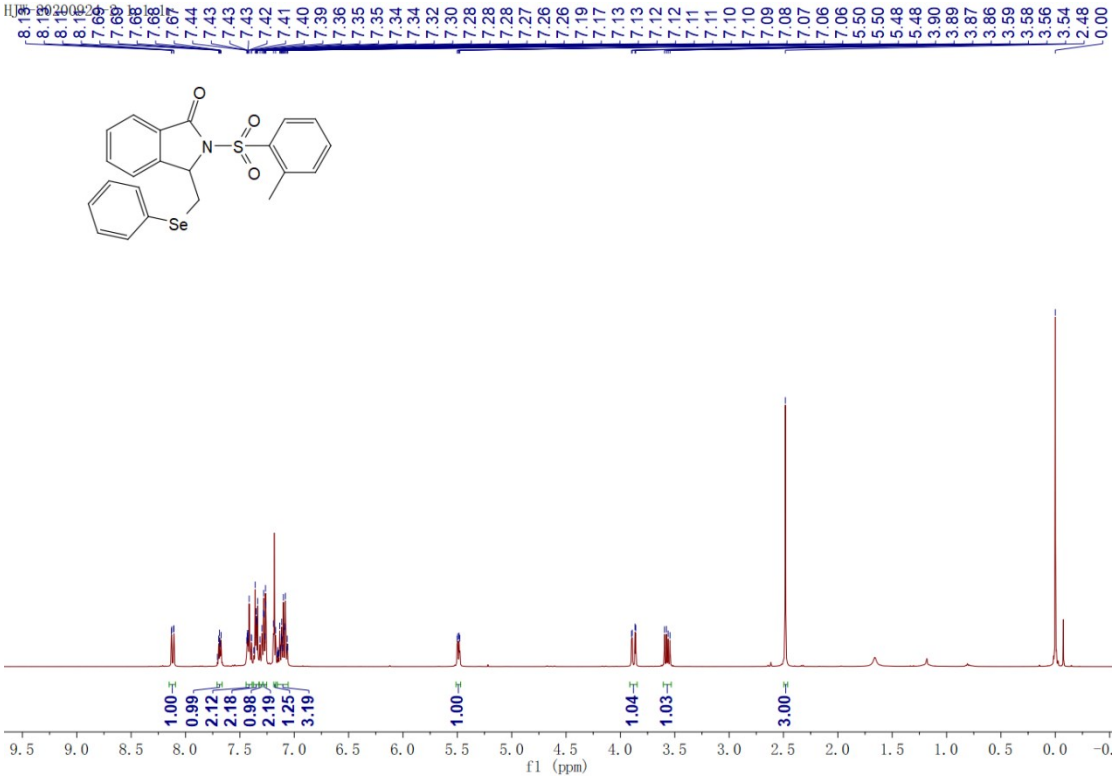

hjw-yiyinduotong-shang.10.1.1r
7.93 7.93 7.92 7.92 7.90 7.72 7.70 7.34 7.34 7.33 7.32 7.32 7.31 7.30 7.30 7.28 7.28 7.27 7.27 7.26 7.24 7.22 7.15 7.15 7.14 7.13 7.12 7.11 7.10 7.09 7.09 7.06 7.04 7.03 7.02 5.45 5.44 5.43 3.75 3.72 3.71 3.66 3.64 3.62 3.61 2.33 0.00
O
N
S
O
O
Se
2.01 0.99 1.15 1.94 2.03 3.03 2.02 1.00 1.03 1.01 3.04
f1 (ppm)
hjw-yiyinduotong-shang.2.1.1r
165.43 144.14 143.16 134.79 132.49 132.26 128.89 128.64 128.27 128.12 127.92 127.20 126.29 123.67 122.22 76.34 76.03 75.71 59.89 31.84 20.68 0.00
f1 (ppm)

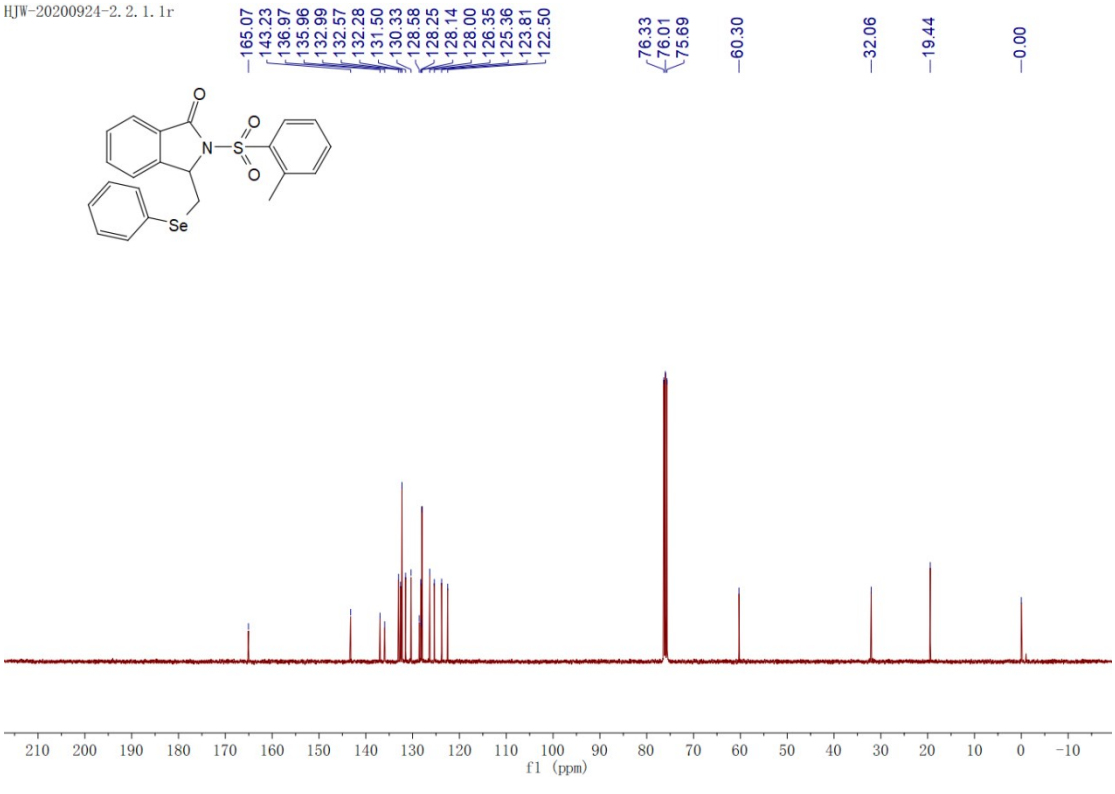
Product **4b**


7.96 7.96 7.95 7.94 7.94 7.93 7.71 7.71 7.69 7.69 7.45 7.44 7.44 7.43 7.42 7.41 7.32 7.32 7.31 7.31 7.30 7.29 7.28 7.28 7.27 7.27 7.26 7.16 7.15 7.14 7.13 7.12 7.10 7.09 7.08 7.08 7.08 7.05 7.05 7.03 7.03 7.02 7.01 7.01 5.45 5.44 5.44 5.43 3.76 3.76 3.73 3.72 3.65 3.64 3.62 3.60 1.22 0.00
O
N
S
O
O
Se
2.02 1.05 2.10 3.21 2.06 1.16 2.10 1.00 1.05 1.00 9.03
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

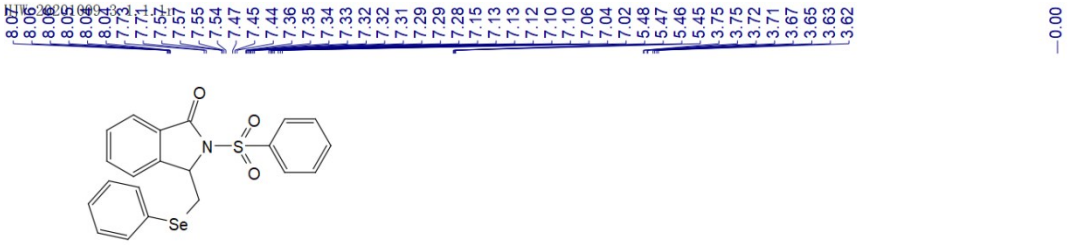

HJW-20200919-1.2.1.1r
165.44 156.93 143.22 134.73 132.51 132.23 128.90 128.30 128.12 127.93 127.02 126.28 125.05 123.63 122.27 76.38 76.06 75.75 59.94 34.24 31.85 29.96 0.00
O
N
S
O
O
Se
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

Product **4c**

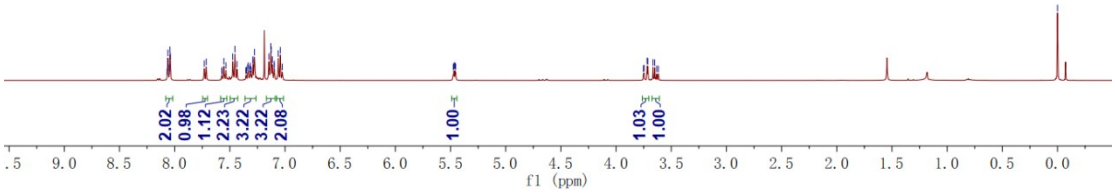

8.13
8.12
8.11
8.10
7.69
7.68
7.67
7.66
7.65
7.44
7.43
7.43
7.42
7.41
7.40
7.39
7.36
7.35
7.35
7.34
7.34
7.32
7.30
7.28
7.28
7.27
7.26
7.26
7.19
7.17
7.13
7.13
7.12
7.12
7.11
7.11
7.10
7.10
7.09
7.08
7.07
7.06
7.06
5.50
5.50
5.48
3.90
3.89
3.87
3.86
3.59
3.58
3.56
3.54
2.48
0.00
O
N
S
O
O
Se
1.00
0.99
2.12
2.18
0.98
2.19
1.25
3.19
1.00
1.04
1.03
3.00
f1 (ppm)

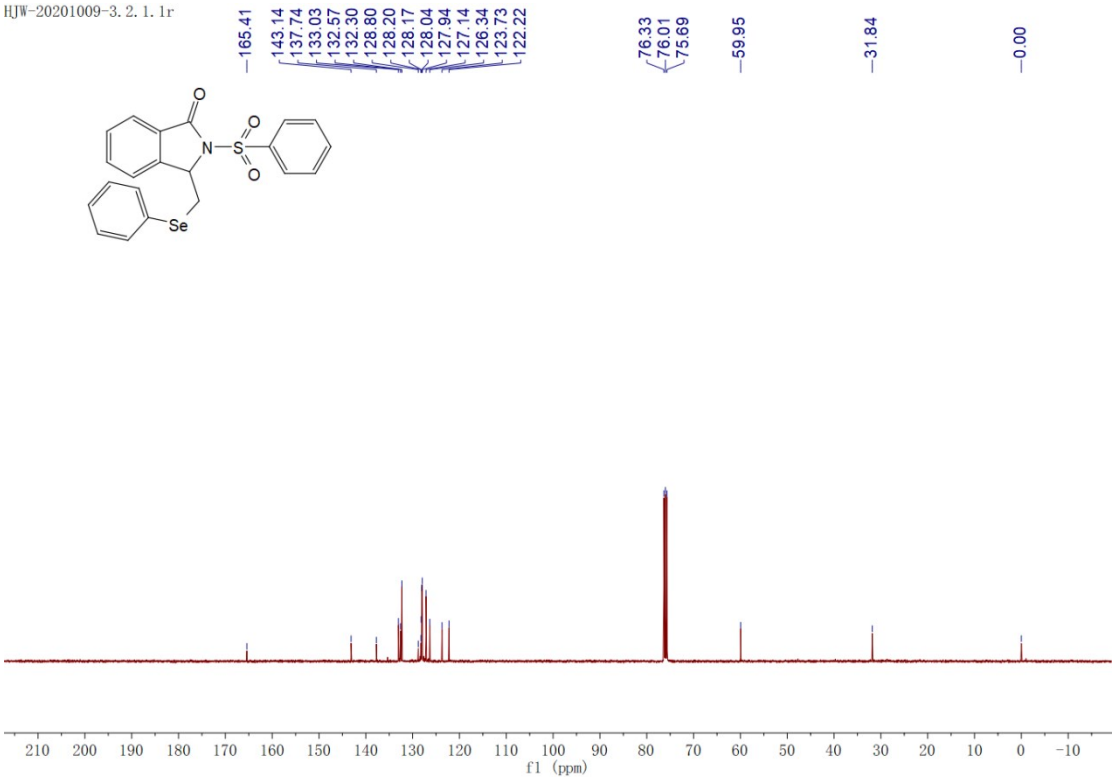

HJW-20200924-2.2.1.1r
165.07
143.23
136.97
135.96
132.99
132.57
132.28
131.50
130.33
128.58
128.25
128.14
128.00
126.35
125.36
123.81
122.50
76.33
76.01
75.69
60.30
32.06
19.44
0.00
O
N
S
O
O
Se
f1 (ppm)

Product **4d**


8.07
8.06
8.06
8.05
8.05
8.04
8.04
7.73
7.71
7.57
7.57
7.55
7.54
7.47
7.45
7.44
7.36
7.35
7.34
7.33
7.32
7.32
7.31
7.29
7.29
7.28
7.15
7.13
7.13
7.12
7.10
7.10
7.06
7.04
7.02
5.48
5.47
5.46
5.45
3.75
3.75
3.72
3.71
3.67
3.65
3.63
3.62
0.00

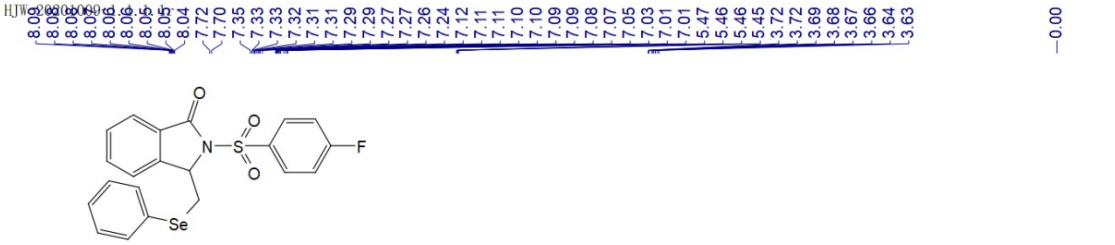
O
N
S
O
O
Se


2.02
0.98
1.12
2.23
3.22
3.22
2.08
1.00
1.03
1.00
f1 (ppm)

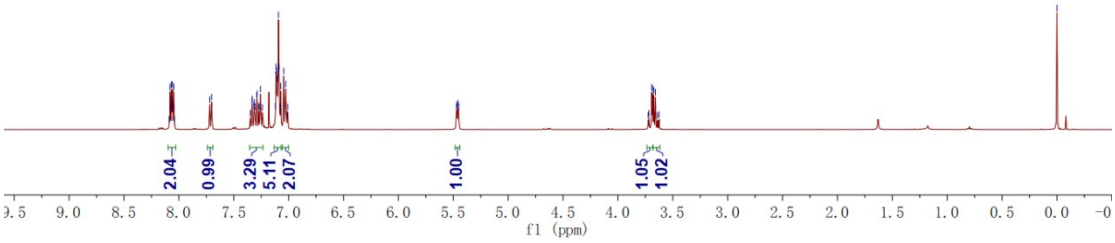

HJW-20201009-3.2.1.1r
165.41
143.14
137.74
133.03
132.57
132.30
128.80
128.20
128.17
128.04
127.94
127.14
126.34
123.73
122.22
76.33
76.01
75.69
59.95
31.84
0.00
f1 (ppm)

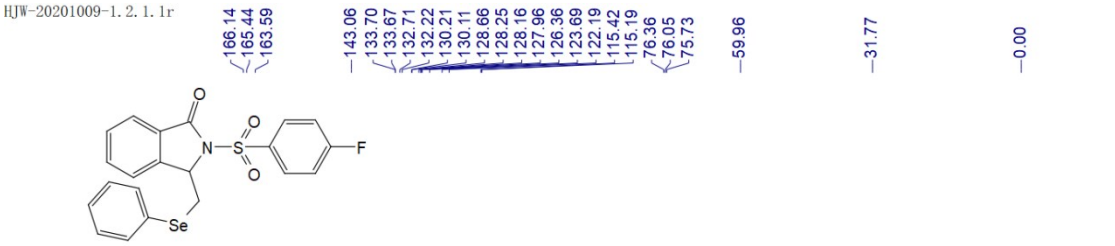
O
N
S
O
O
Se

Product **4e**


8.09
8.08
8.06
8.05
8.04
7.72
7.70
7.35
7.33
7.32
7.31
7.29
7.27
7.26
7.24
7.12
7.11
7.10
7.09
7.08
7.07
7.05
7.03
7.01
5.47
5.46
5.45
3.72
3.69
3.68
3.67
3.66
3.64
3.63
0.00

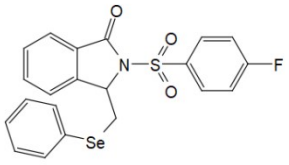
O
N
S
O
O
F
Se


2.04
0.99
3.29
5.11
2.07
1.00
1.05
1.02
f1 (ppm)

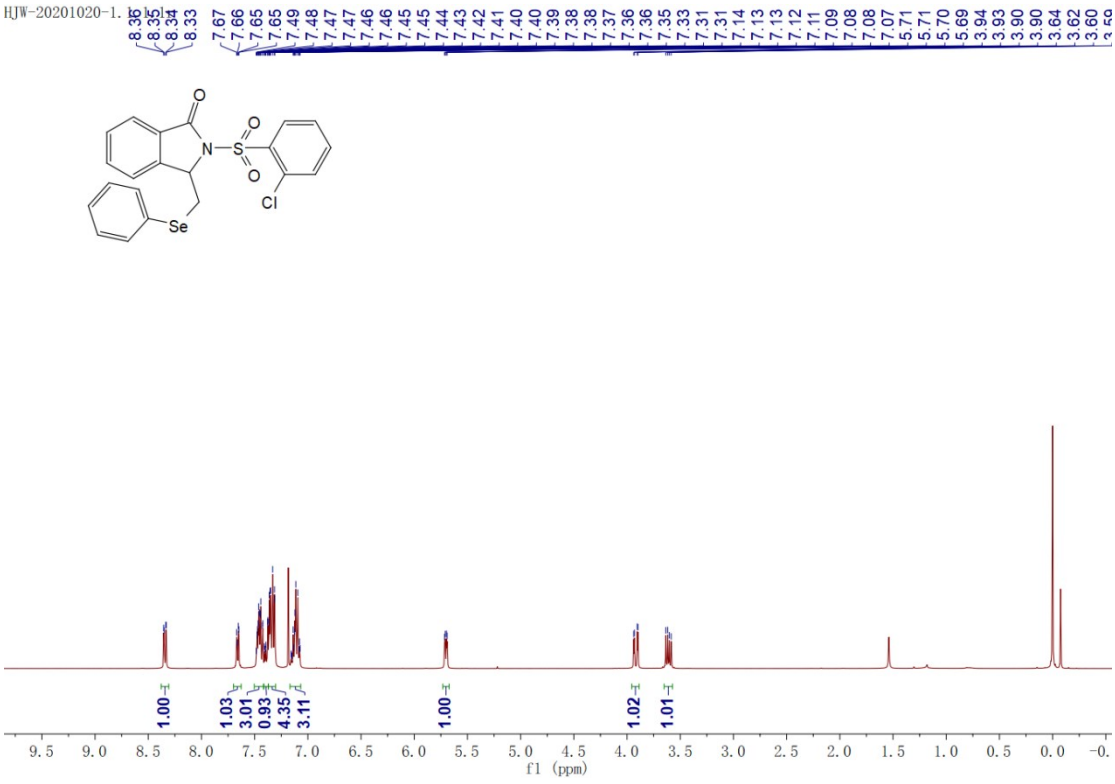

HJW-20201009-1.2.1.1r
166.14
165.44
163.59
143.06
133.70
133.67
132.71
132.22
130.21
130.11
128.66
128.25
128.16
127.96
126.36
123.69
122.19
115.42
115.19
76.36
76.05
75.73
59.96
31.77
0.00
f1 (ppm)

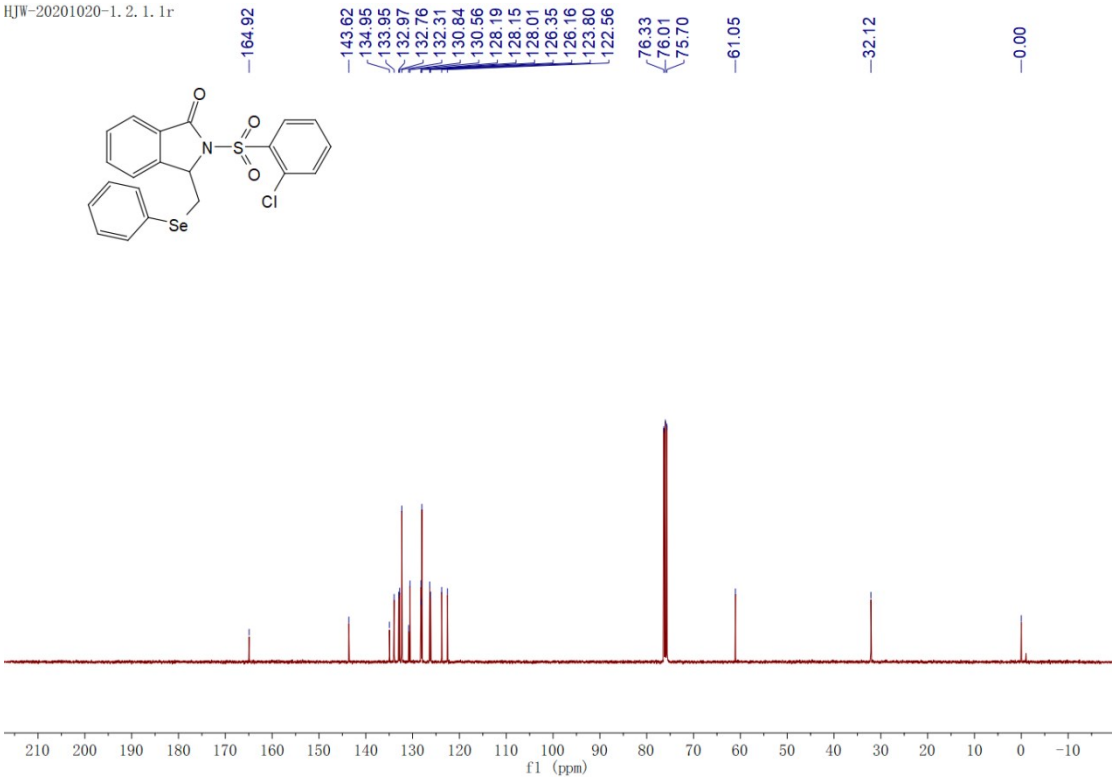
O
N
S
O
O
F
Se

HJW-20201009-1.3.1.1r

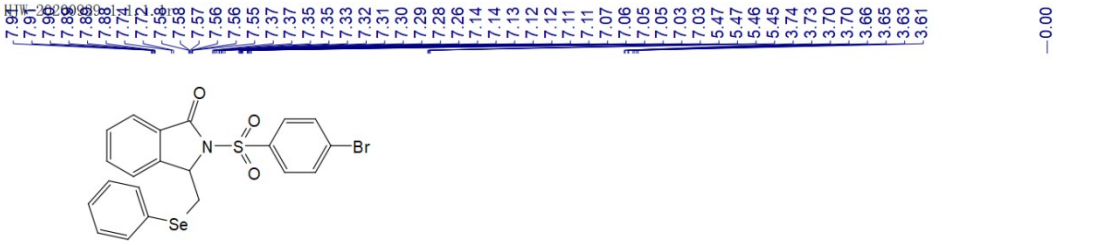


Product **4f**

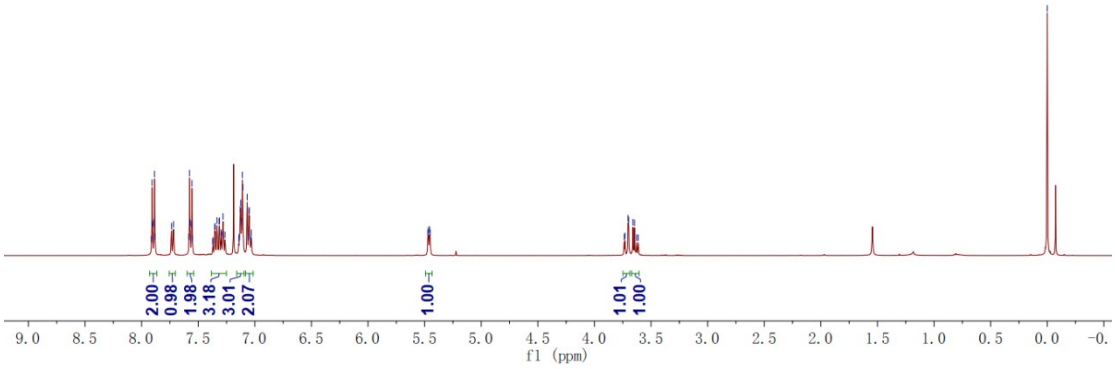

HJW-20201020-1.
8.36
8.35
8.34
8.33
7.67
7.66
7.65
7.65
7.49
7.48
7.47
7.47
7.46
7.46
7.45
7.45
7.44
7.43
7.42
7.41
7.40
7.40
7.39
7.38
7.38
7.37
7.36
7.36
7.35
7.33
7.31
7.31
7.14
7.13
7.13
7.12
7.11
7.09
7.08
7.08
7.07
5.71
5.71
5.70
5.69
3.94
3.93
3.90
3.90
3.90
3.64
3.62
3.60
O
N
S
O
O
Cl
Se
1.00
1.03
3.01
0.93
4.35
3.11
1.00
1.02
1.01
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

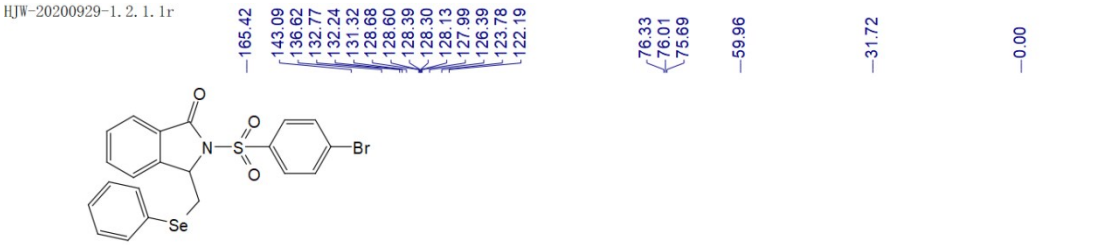

HJW-20201020-1.2.1.1r
164.92
143.62
134.95
133.95
132.97
132.76
132.31
130.84
130.56
128.19
128.15
128.01
126.35
126.16
123.80
122.56
76.33
76.01
75.70
61.05
32.12
0.00
O
N
S
O
O
Cl
Se
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
−10
f1 (ppm)

Product **4g**

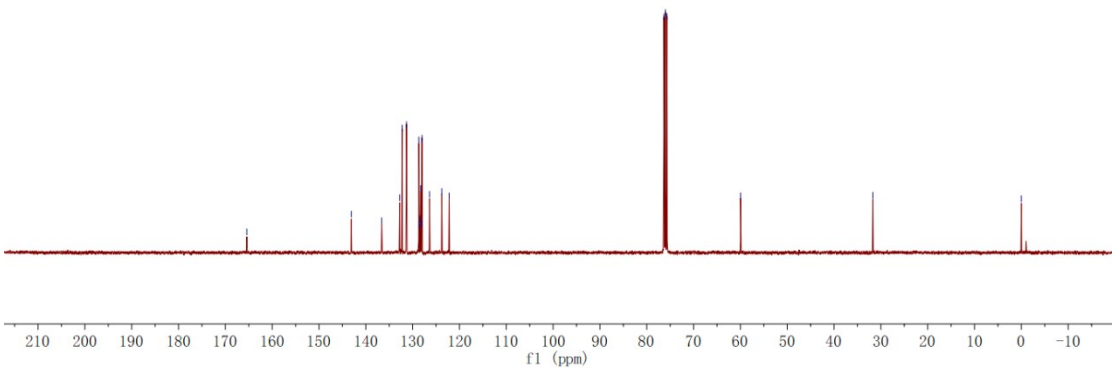

7.94
7.91
7.90
7.89
7.88
7.88
7.74
7.72
7.58
7.58
7.57
7.56
7.56
7.55
7.37
7.37
7.35
7.35
7.33
7.32
7.31
7.30
7.29
7.28
7.26
7.14
7.14
7.13
7.12
7.12
7.11
7.11
7.07
7.06
7.05
7.05
7.03
7.03
5.47
5.46
5.45
3.74
3.73
3.70
3.70
3.66
3.65
3.63
3.61
0.00

O
N
S
O
O
Br
Se

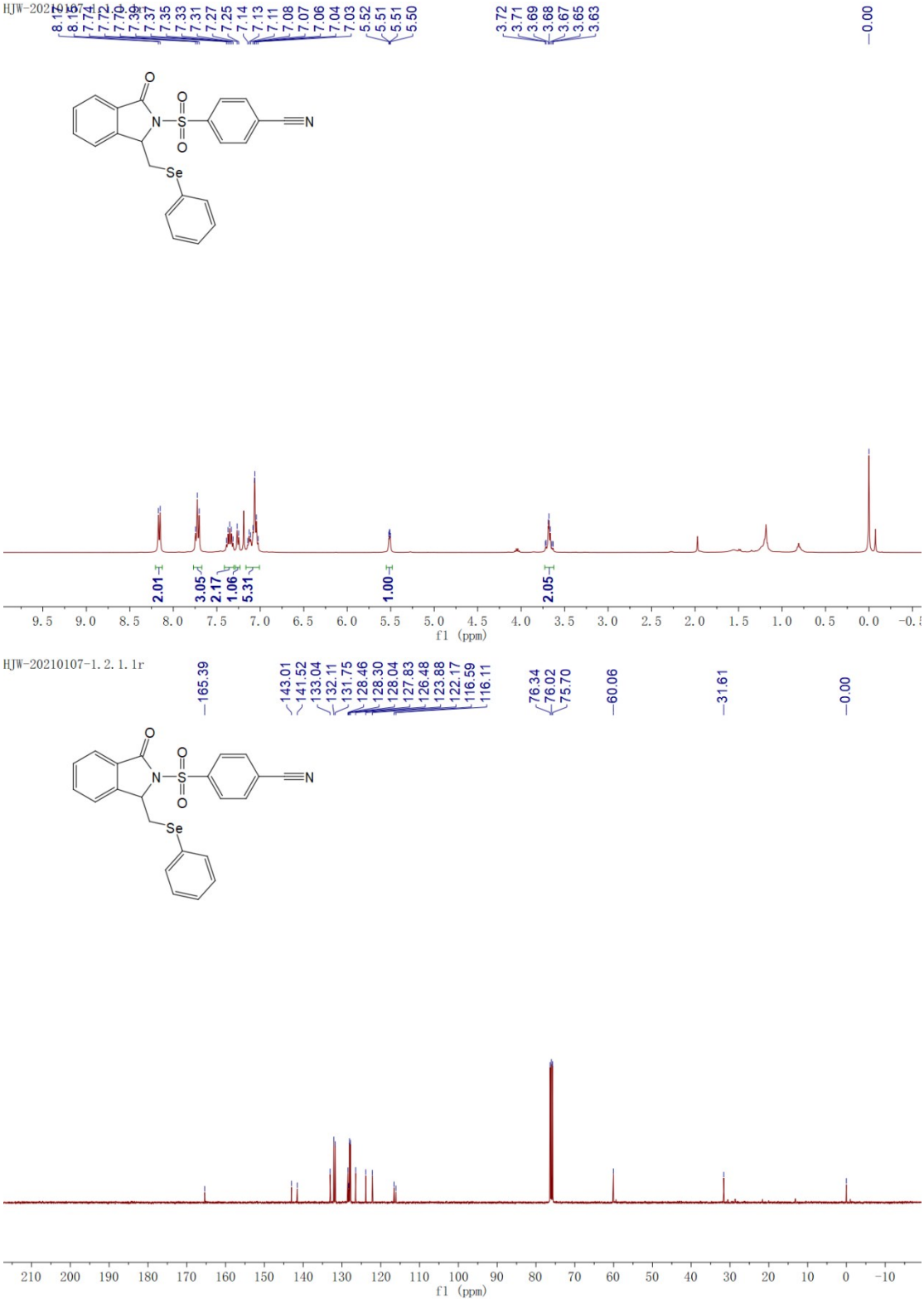

2.00
0.98
1.98
3.18
3.01
2.07
1.00
1.01
1.00
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.
f1 (ppm)


HJW-20200929-1.2.1.1r
165.42
143.09
136.62
132.77
132.24
131.32
128.68
128.60
128.39
128.30
128.13
127.99
126.39
123.78
122.19
76.33
76.01
75.69
59.96
31.72
0.00

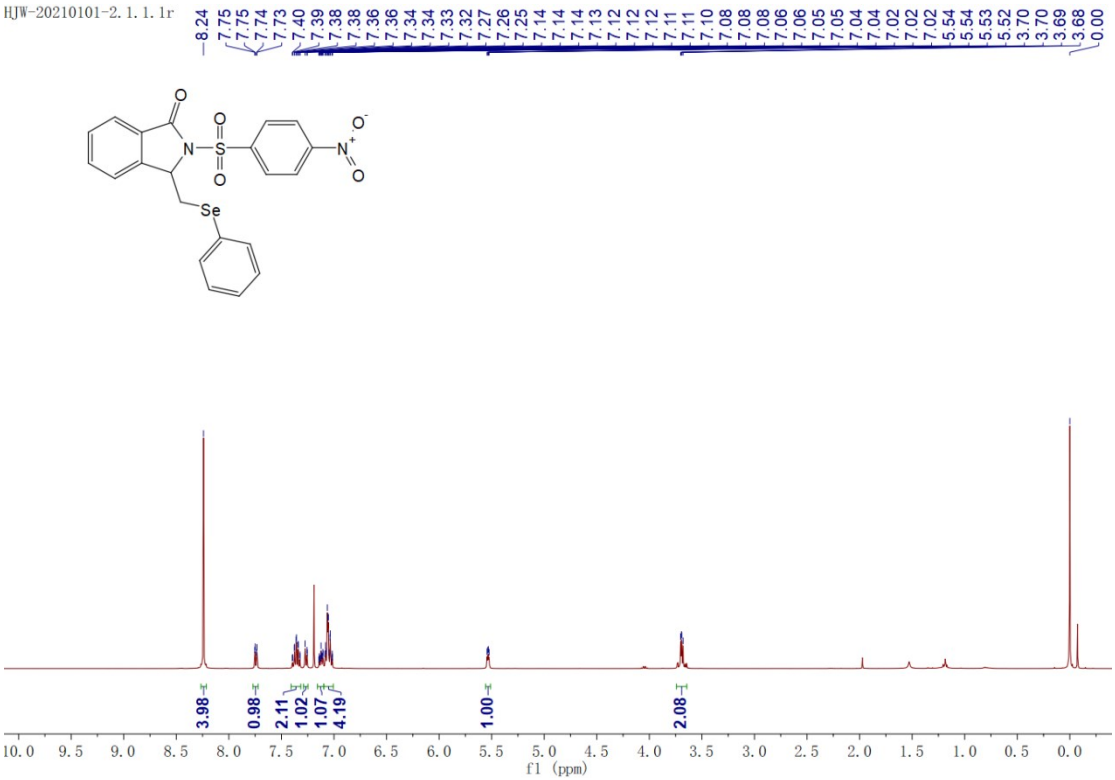
O
N
S
O
O
Br
Se

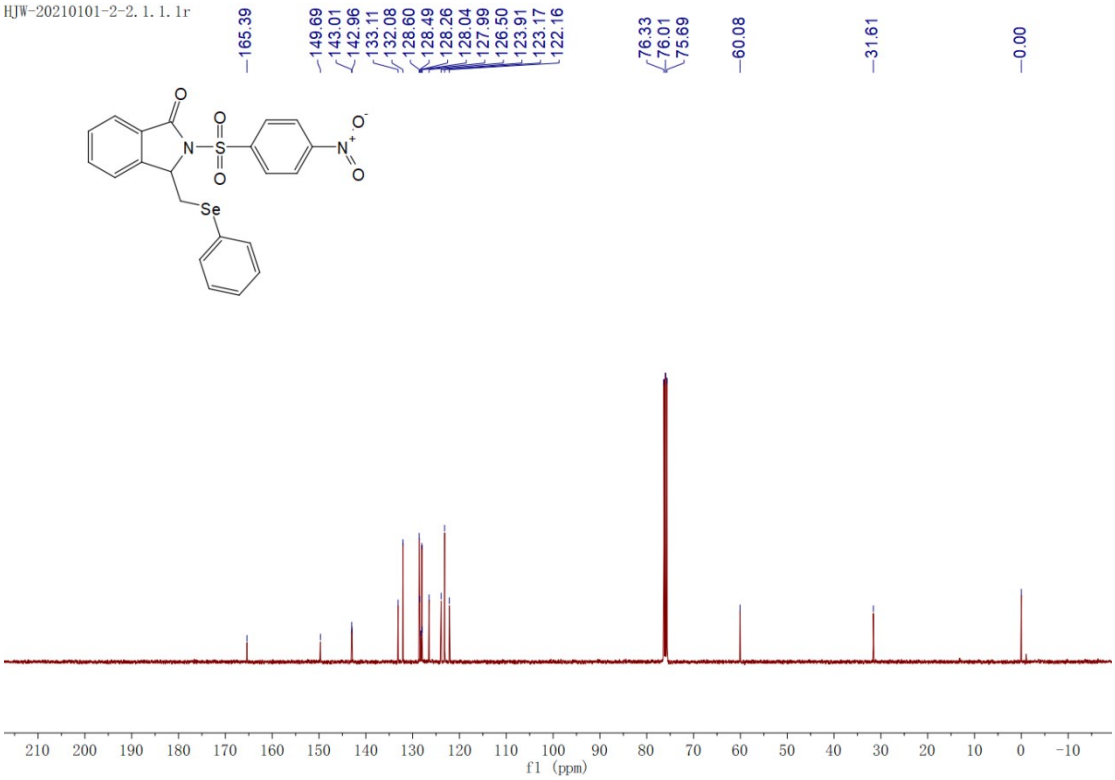

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

Product **4h**

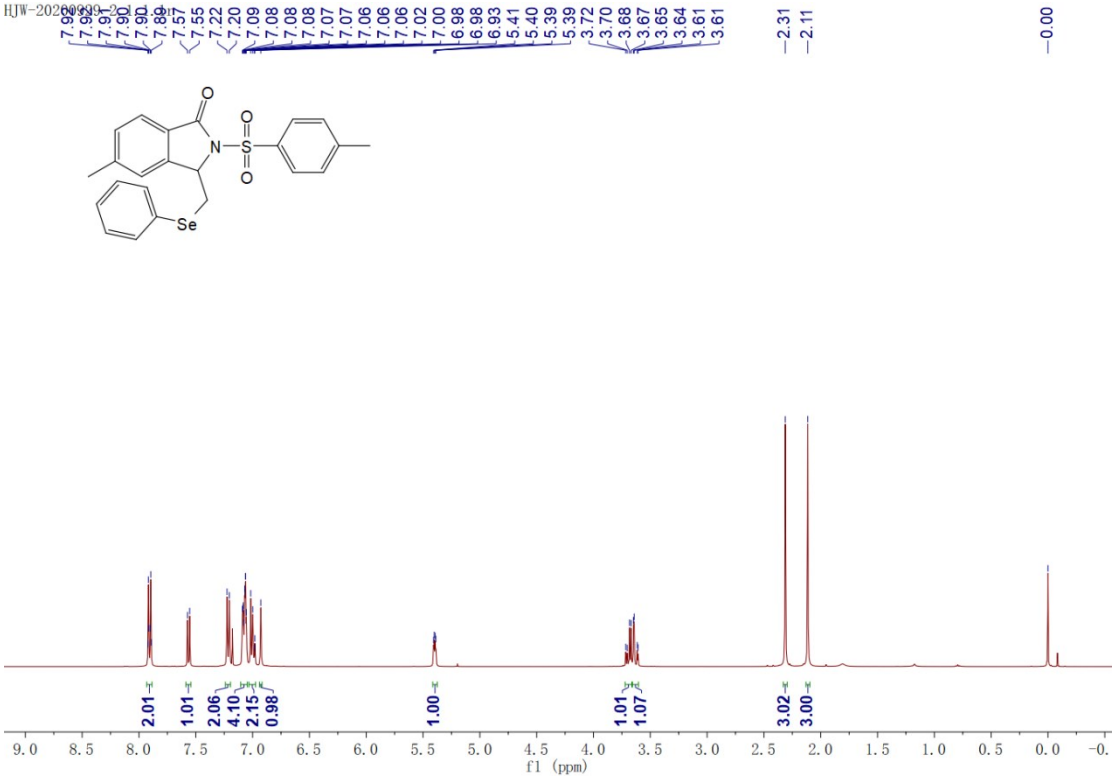

HJW-20210107
8.17
8.15
7.74
7.72
7.70
7.39
7.37
7.35
7.33
7.31
7.27
7.25
7.14
7.13
7.11
7.08
7.07
7.06
7.04
7.03
5.52
5.51
5.51
5.50
3.72
3.71
3.69
3.68
3.67
3.65
3.63
0.00
O
N
S
O
O
N
Se
2.01
3.05
2.17
1.06
5.31
1.00
2.05
f1 (ppm)
HJW-20210107-1.2.1.1r
165.39
143.01
141.52
133.04
132.11
131.75
128.46
128.30
128.04
127.83
126.48
123.88
122.17
116.59
116.11
76.34
76.02
75.70
60.06
31.61
0.00
f1 (ppm)

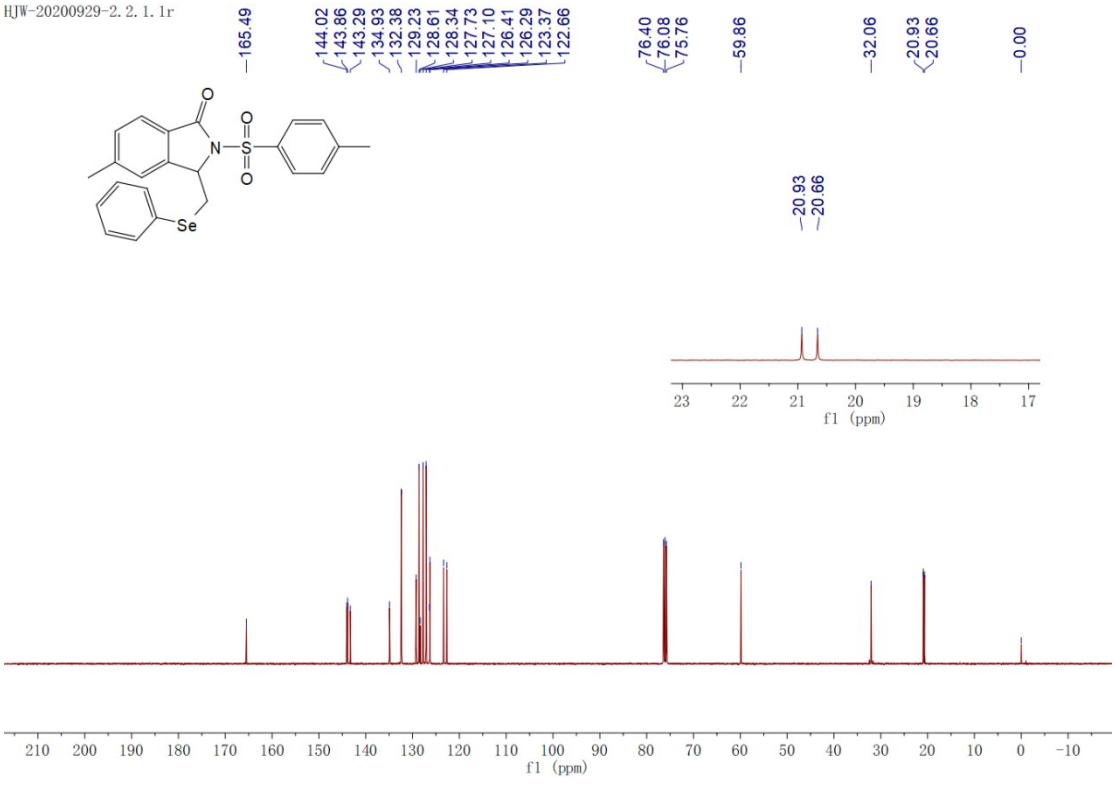
Product **4i**


HJW-20210101-2.1.1.1r
8.24
7.75
7.74
7.73
7.40
7.39
7.38
7.36
7.36
7.34
7.34
7.33
7.32
7.27
7.26
7.25
7.14
7.14
7.14
7.13
7.12
7.12
7.12
7.11
7.11
7.10
7.08
7.08
7.08
7.06
7.06
7.05
7.05
7.04
7.04
7.02
7.02
7.02
5.54
5.54
5.53
5.52
3.70
3.70
3.69
3.68
0.00
O
O
N
S
O
O
O
N
O
Se
3.98
0.98
2.11
1.02
1.07
4.19
1.00
2.08
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

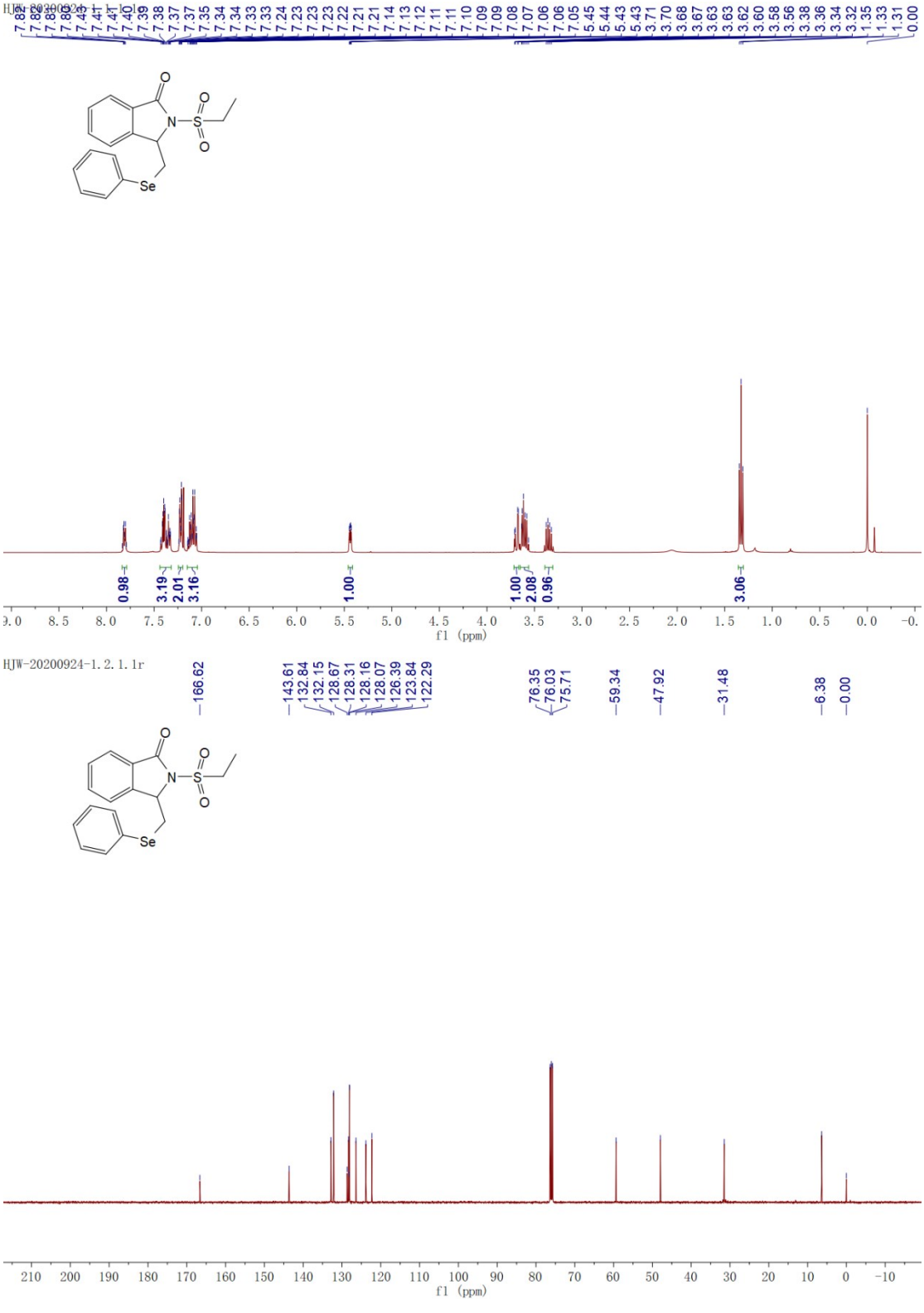

HJW-20210101-2-2.1.1.1r
165.39
149.69
143.01
142.96
133.11
132.08
128.60
128.49
128.26
128.04
127.99
126.50
123.91
123.17
122.16
76.33
76.01
75.69
60.08
31.61
0.00
O
O
N
S
O
O
O
N
O
Se
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

Product **4j**


HJW-20200929-2
7.93
7.92
7.91
7.90
7.90
7.89
7.57
7.55
7.22
7.20
7.09
7.08
7.08
7.08
7.07
7.07
7.06
7.06
7.06
7.02
7.00
6.98
6.98
6.93
5.41
5.40
5.39
5.39
3.72
3.70
3.68
3.67
3.65
3.64
3.61
3.61
2.31
2.11
0.00
O
N
S
O
O
Se
2.01
1.01
2.06
4.10
2.15
0.98
1.00
1.01
1.07
3.02
3.00
f1 (ppm)


HJW-20200929-2.2.1.1r
165.49
144.02
143.86
143.29
134.93
132.38
129.23
128.61
128.34
127.73
127.10
126.41
126.29
123.37
122.66
76.40
76.08
75.76
59.86
32.06
20.93
20.66
0.00
O
N
S
O
O
Se
20.93
20.66
f1 (ppm)
f1 (ppm)

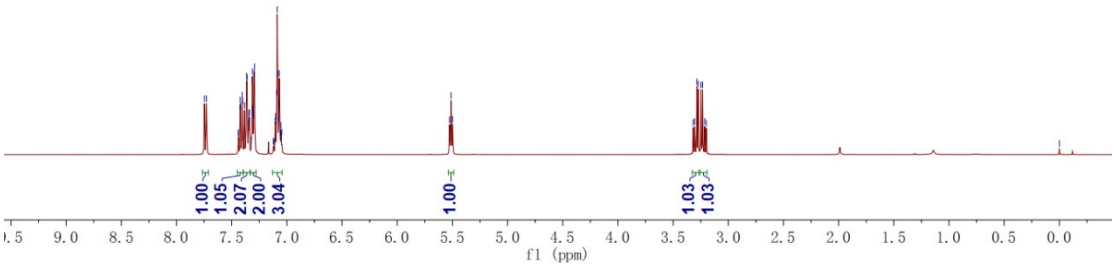
Product **4k**

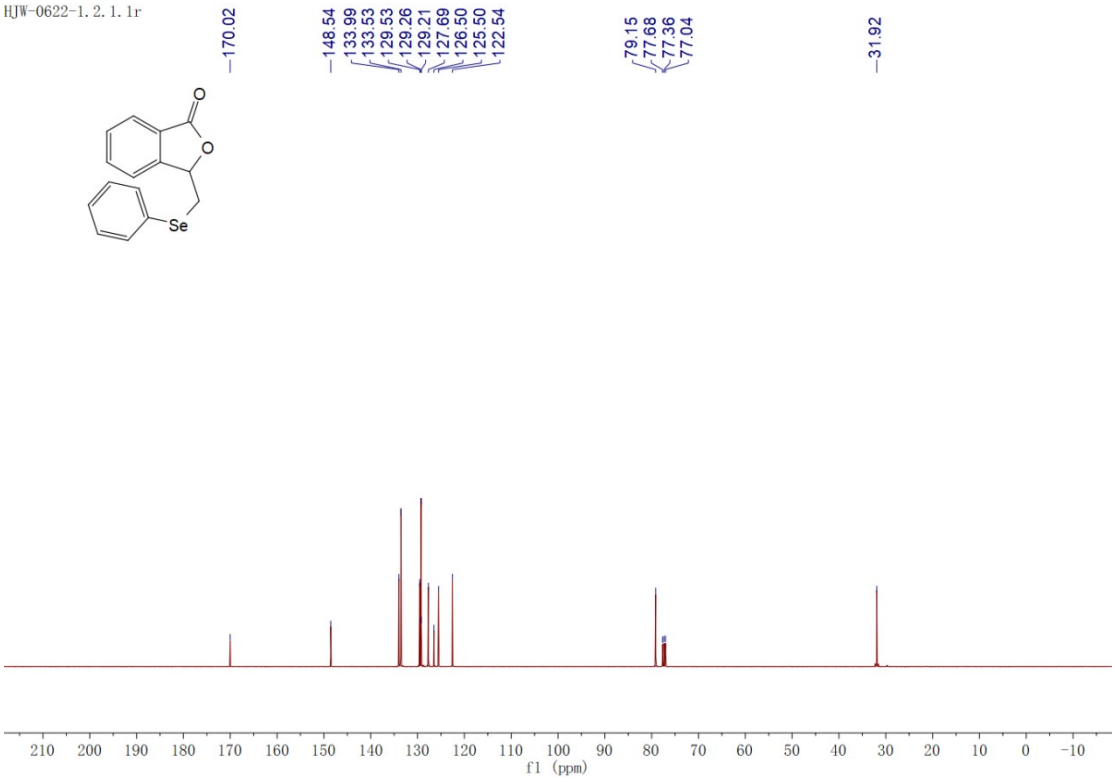

HJW-20200924-1.2.1.1r
7.82 7.80 7.80 7.80 7.45 7.41 7.41 7.40 7.40 7.39 7.38 7.37 7.37 7.35 7.34 7.34 7.33 7.33 7.24 7.23 7.23 7.23 7.22 7.21 7.21 7.14 7.13 7.12 7.11 7.11 7.10 7.09 7.09 7.08 7.07 7.06 7.06 7.05 5.45 5.44 5.43 5.43 3.71 3.70 3.68 3.67 3.63 3.63 3.62 3.60 3.58 3.56 3.38 3.36 3.34 3.32 1.35 1.33 1.31 0.00
O
N
S
O
O
Se
0.98 3.19 2.01 3.16 1.00 1.00 2.08 0.96 3.06
f1 (ppm)
HJW-20200924-1.2.1.1r
166.62 143.61 132.84 132.15 128.67 128.31 128.16 128.07 126.39 123.84 122.29 76.35 76.03 75.71 59.34 47.92 31.48 6.38 0.00
f1 (ppm)

Product **5**


7.75
7.73
7.44
7.44
7.42
7.42
7.40
7.40
7.38
7.36
7.36
7.35
7.35
7.34
7.34
7.32
7.32
7.31
7.31
7.30
7.30
7.29
7.12
7.12
7.11
7.10
7.09
7.09
7.08
7.08
7.07
7.07
7.06
7.05
7.05
7.05
5.53
5.51
5.50
3.32
3.31
3.29
3.27
3.25
3.23
3.21
3.20
0.00

O
O
Se


1.00
1.05
2.07
2.00
3.04
1.00
1.03
1.03
f1 (ppm)


HJW-0622-1.2.1.1r
170.02
148.54
133.99
133.53
129.53
129.26
129.21
127.69
126.50
125.50
122.54
79.15
77.68
77.36
77.04
31.92
f1 (ppm)

O
O
Se